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TWENTY-THIRD

ANNUAL REPORT

OF THE

LOWELL WATER BOARD

TO THE

CITY COUNCIL OF THE CITY OF LOWELL, MASS.,

AND THE

REPORTS OF THE SUPERINTENDENT OF WATER WORKS  
AND OF THE CITY ENGINEER TO THE  
WATER BOARD FOR 1895

LOWELL, MASS.:  
PRINTED BY THOMPSON & HILL — THE VOX POPULI PRESS.  
1896.



612753

## CITY OF LOWELL.

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IN BOARD OF ALDERMEN, Jan. 21, 1896.

Received and ordered on file ; sent down for concurrence.

GIRARD P. DADMAN, *City Clerk*.

NOV 23  
1896  
V. A. 381

IN COMMON COUNCIL, Jan. 21, 1896.

Received and ordered on file, in concurrence.

FRANK N. OWEN, *Clerk*.

# WATER DEPARTMENT, 1895.

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## WATER BOARD:

GEORGE E. PUTNAM, *President.*

Term expires second Monday in March, 1897.

FRANK L. WEAVER,

Term expires second Monday in March, 1896.

AUGUST FELS,

Term expires second Monday in March, 1898.

STEPHEN H. JONES,

Term expires second Monday in March, 1899.

WILLIAM L. HILLS,

Term expired first Monday in January, 1896.  
(Or on election of successor.)

J. W. CRAWFORD, *Temporary Secretary and Clerk.*

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ROBERT J. THOMAS, *Superintendent.*

GEORGE BOWERS, *City Engineer.*

---

DANIEL HART, JR., *Engineer.*

WILLIAM JOYCE, *Asst. Foreman.*

THOMAS MCLOUGHLIN, *Asst. Engineer.*

WALTER P. WILEY, *Meters.*

FRANK LAPOINT, *Reservoir.*

D. B. H. BARTLETT, *Foreman Shop.*

THOMAS F. DOYLE, *Foreman.*

A. F. COGER, *Hydrants and Gates.*

THOMAS ROGERS, *Services.*

---

## OFFICE:

LEONARD T. FARRIS, *Service Clerk.*

GERTRUDE W. BYAM, *Bookkeeper.*

JULIA J. RAFTER, *Asst. Bookkeeper.*

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## INSPECTORS:

ROBERT GARDNER, JR.

MICHAEL H. MCCUE.

GEORGE E. WORTHEN.

GEORGE F. TILTON.

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W304

# REPORT OF THE WATER BOARD.

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OFFICE OF THE WATER BOARD,  
CITY HALL.

LOWELL, MASS., Jan. 14, 1896.

*To His Honor the Mayor and the City Council of the  
City of Lowell:*

The Water Board herewith present their twenty-third annual report covering the operations of the department for the year ending December 31, 1895.

Owing to a failure of the City Council to elect their successors, Messrs. Brennan and Stanley held over, and the vacancy in the Board caused by the death of Mr. R. B. Allen remained unfilled until the year was half gone.

In accordance with the ordinances the Board organized on March 11 by the unanimous choice of Mr. Brennan as President, and Robert J. Thomas as Superintendent. July 16, Mr. S. H. Jones was elected to the vacancy. August 2, Mr. William L. Hills was elected a member from the Board of Aldermen. October 8, Mr. Jones was elected to succeed Mr. Brennan, whose term expired in March,

1895. Mr. Brennan thus retiring after eight years continuous service as a member of the Water Board, five of which he served as President of the Board, and through his energy and ability the Water Department stands as one of the best municipal water plants in the country.

Nov. 13, Mr. Frank L. Weaver was elected to fill the vacancy, and the Board once more had a complete membership.

Mr. George E. Putnam was elected President of the Board to succeed Mr. Brennan.

March 2, Mr. Charles L. Knapp, Clerk and Secretary of the Board since 1888, resigned his position, having accepted a responsible position elsewhere. October 1, Miss Mary G. Sawyer resigned her position as Clerk, and Miss Julia J. Rafter was elected to the vacancy under civil service rules. Previous to Mr. Knapp's resignation the Board had called on the Civil Service Commission for a clerk for temporary work in the office, and Mr. J. W. Crawford was certified. After the resignation another request was made for names from which to select one for Clerk and Secretary of the Board, but Mr. Crawford's work being satisfactory, he was continued in that capacity throughout the year.

On January 3, a contract was awarded the McNeil Pipe and Foundry Co. for 200 tons 6-inch pipe, 150 tons 8-inch pipe, and 450 tons 20-inch pipe, at \$21.25 per gross ton, delivered in Lowell. This 20-inch pipe was for purpose of connecting the upper

or Chelmsford wells plant with the lower plant, and the small pipe for general use. April 18, a contract was awarded the Anniston Pipe and Foundry Co. for 150 tons 12-inch pipe, at \$19.70 per ton, delivered; August 15, 100 tons 6-inch pipe to R. D. Wood & Co., at \$23.85 per ton, delivered; and August 29, 700 tons 24-inch pipe to Chattanooga Pipe and Foundry Co., at \$21.75 per ton, delivered. This latter pipe was to connect the Boulevard wells with the filter gallery.

During the last session, the Legislature authorized the City of Lowell to take land in Town of Chelmsford, for water works purposes east of Chelmsford street, Lowell road, South street and Boston road, to the dividing line between Chelmsford and Town of Billerica. Under this act the city has purchased 35.15 acres in the valley of River Meadow brook in the northeasterly part of the town, where the Hydraulic Construction Co.'s plant is established, as follows:

Of Charles F. Goss . . . . .	7.80 acres.
George A. Coburn . . . . .	6.96 acres.
Samuel P. Perham . . . . .	10.37 acres.
Albert P. Perham . . . . .	5.89 acres.
John Maguire . . . . .	4.13 acres.

There is a tract of 2.65 acres belonging to P. H. Rafter, which it is the purpose of the Board to ask the City Council to seize by process of law, as present owner cannot give clear title. For convenience

in designating, the various pumping stations have been numbered as follows:

Centralville Station . . . . .	No. 1.
Poor Farm . . . . .	No. 2.
Chelmsford . . . . .	No. 3.
Boulevard . . . . .	No. 4.

On April 5, 1895, the Hydraulic Construction Co. began to pump water at Station No. 3 into the city mains under the terms of their contract with the city to pump not less than 2,000,000 gallons per day for one year. The actual amount pumped into the city from this plant averaged over 3,000,000 gallons per day,

This plant consists of 120 two-inch wells, with two Worthington engines of 3,000,000 gallons daily capacity each. This plant is owned by the Hydraulic Construction Co. As soon as pumping began by the Hydraulic Construction Co., it was found that the increased pressure resulting from the increased amount of water forced into the pipes, made it neccessary to have two new boilers at the Station No. 2, as the boilers there were old ones taken from the Centralville station, and were allowed to carry only 70 lbs. steam pressure. Therefore bids were called for, and on April 20, a contract was awarded Scannell & Wholey for two new boilers for \$1,895.00, to carry 150 lbs. pressure. They were made under specifications furnished by the Hartford Steam Boiler Inspection & Insurance Co., and are insured for one year by the makers.

In their endeavor to procure an adequate supply of pure water, the Board thought it advisable to test the feasibility of Salmon brook and ponds tributary in Dunstable and Groton, and the City Engineer was authorized to make surveys to ascertain the elevation and quantity to be obtained from that source. His report is hereto annexed.

In May the Board of Aldermen was asked to authorize a loan of \$75,000.00 "to Improve and Increase the Driven Wells System or any water than the Merrimack River," loan to run 15 years, and to be paid for out of the income of the department on same principle as previous loans for this purpose; and has been kept as a separate account, and is known as Driven Wells Account No. 2, the other being Driven Wells Account No. 1, but beginning with January 1, 1896, the two accounts will be consolidated into one.

In July a contract was awarded B. F. Smith & Bro., of Boston, for a tube well plant at the Boulevard on same general plan as the contract with Hydraulic Construction Co. The contractor is to "furnish all the material and do all the work necessary to construct and complete a gang of tube wells of sufficient magnitude to furnish and deliver into the city mains not less than 2,000,000 U. S. gallons of ground water each and every day of twenty-four hours, at a station to be hereafter definitely located by the Water Board at Pawtucket Boulevard, for the sum of \$13,461.70 per million gallons."



The city also agrees to pay monthly the said contractor at the rate of ten (10) dollars per million gallons for all water pumped and delivered into the city force main. Under this arrangement, the contractor agrees to provide everything necessary to make a test of the quantity of water that the wells sunk under this contract will yield and supply for a term of one year, and for a further time of six months if the Water Board so elects, and the right is reserved by the city to purchase the pumping plant at the expiration of one year, at a sum not exceeding seventy-five (75) per cent. of its cost to the contractor.

This station is located near the upper end of the Boulevard, from which a 24-inch force main will run to the upper end of the filter gallery, thence the water will run by gravity to the pumping station on West Sixth street, and from there be pumped into the reservoir. As the work of driving wells progressed, it was found necessary to proceed beyond the Boulevard land for water, therefore the Board purchased of Edward S. Howe, 4.38 acres, and of Thomas J. Underwood, 2.88 acres of land on which to drive wells, and as a guard against pollution from that side of the Boulevard.

Wishing to increase and improve the efficiency of the well plants to their utmost, the Superintendent was authorized to connect the "Andrews Wells" at the Poor Farm with the Cook plant, being a gang of seven wells, the first put down in this locality

in 1892, also, 12 additional wells were driven, making 91 wells altogether at this plant, varying from two to six inches in diameter. It was also decided to lower the Cook plant 8 feet, thereby to increase the amount of water obtained and the efficiency of the plant. This plant has furnished the following supply of water.

## P. S. No. 2.

January . . . . .	73,978,659	gallons.
February . . . . .	59,762,451	"
March . . . . .	80,396,400	"
April . . . . .	89,764,504	"
May . . . . .	80,136,394	"
June . . . . .	76,371,482	"
July . . . . .	78,087,950	"
August . . . . .	67,469,526	"
September . . . . .	48,073,848	"
October . . . . .	62,087,956	"
November . , . . .	81,169,168	"
December . . . . .	99,507,538	"

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896,805,876 gallons.

Average 2,457,002 " daily.

Believing that the capacity of the driven wells is sufficient under proper control to furnish the city with pure water for a number of years to come, and that the water meter affords that control, the City Council was asked early in the year for a joint committee to meet with the Water Board to take steps looking to the metering of all water sold by the city. The committee as appointed consisted of aldermen Varnum and Dow and councilmen O'Day, Miskella, and Rivet. The first meet-

ing was on September 20, and the committee finally adopted a favorable report to present to the City Council, recommending a resolution to amend the city ordinances to allow of the Water Board adopting a free meter system; also one to authorize a loan of \$40,000.00 to pay for the meters now in use, it being the plan to refund to those persons owning meters the amount paid less 10 per cent. per year while in use, any meter being in use 10 years being considered as having served its usefulness, although it might last a great while longer, but it would have to be replaced by the city when it did fail. About 2,000 meters must be purchased under these conditions at the present time.

August 1, a communication was received from Josiah Butler, for himself and the Lowell Waste Company, making a proposition to sell to the City of Lowell all the water rights owned by them in River Meadow brook and Hart's pond in Chelmsford for the sum of \$40,000.00. After due consideration and consultation with the City Solicitor, the Board was of the opinion that the water rights offered were of too uncertain a character and too limited in their scope to justify so large an expenditure by the city at the present time.

In October a second test of the Morris engine was made to determine a final settlement of the contract with Wheelock Engine Co., and a duty of 108,056,120 ft. pounds was obtained, being 7,943,880 ft. pounds less than guaranteed, for which a forfeit of

\$200.00 per million ft. pounds was deducted from the contract price. The cost of the repairs has been \$8,499.72; this includes the expense to the department in addition to the amount of contract with the Wheelock Engine Co. The engine is now first class, with a new steam end, and is a better engine than ever before.

The finances of the department are shown in the tables of the Secretary annexed, but a concise statement may be appreciated by some who do not care to study the details:

Charged for water . . . . .	\$218,431 63
Other charges . . . . .	20,324 84
Transfer account from 1894 . . . . .	28,181 95
	<hr/>
	\$266,938 42
Collections . . . . .	\$209,588 74
Discount . . . . .	21,349 50
Abatement . . . . .	3,428 99
Uncollected, to transfer . . . . .	32,571 19
	<hr/>
	\$266,938 42

The amount charged for water increased \$11,494.62 over 1894, of which increase \$10,944.94 was for metered water; other charges increased \$1,694.10.

The total income was . . . . .	\$209,588 74
Out-go . . . . .	207,614 07
	<hr/>
Excess over out-go . . . . .	\$1,974 67
Balance cash to 1896 account . . . . .	\$30,886 41
The Driven Well balance Jan. 1, 1895, was	\$74,574 48
Received from Water Works . . . . .	12,459 10
Received from Water Loan . . . . .	75,000 00
	<hr/>
	\$162,033 58

## Expended:

Chelmsford Plant . . . . .	\$66,225 07
Boulevard Plant . . . . .	36,495 93
	<hr/>
	\$102,721 00

Leaving a balance of \$59,312.58 to driven wells account, January 1st, 1896.

The report of Superintendent Thomas, hereto annexed, and the report of Engineer Bowers will give more detailed account of the workings of the department and will be found to be of interest.

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REPORT OF CITY ENGINEER ON SALMON BROOK  
AND PONDS TRIBUTARY.

(COPY.)

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OFFICE OF THE CITY ENGINEER,  
CITY HALL,

LOWELL, MASS., June 1, 1895.

TO THE LOWELL WATER BOARD, LOWELL, MASS.

*Gentlemen:*—In accordance with your vote passed March 27, 1895, I have made an investigation as to the drainage area and the elevation of several ponds in the valley of Salmon brook, in the

towns of Dunstable, Groton, and Tyngsborough; also of some ponds in Westford and Chelmsford whose waters are tributary to Stony brook. The drainage areas are calculations taken from the state map. The elevations are from actual levels.

The drainage area of Salmon brook, south of Pleasant street, in the town of Dunstable, is about fifteen and twenty-five hundredths (15.25) square miles. This may be divided into two sections, one section extending from Pleasant street, in Dunstable, to the Groton road just north of Cow pond, and containing about seven and sixty-three hundredths (7.63) square miles. The ponds in this section are Upper and Lower Massapoag. The remaining part of the drainage area of this brook, about seven and sixty-seven hundredths (7.67) square miles, includes Cow pond, Baddacook pond, and what is now known as Knops pond. This last named pond includes what were formerly known as Knops, Duck, and Spring ponds. These three ponds were made into one by the construction of a dam south of Cow pond, which caused the water to overflow them and cover a large extent of land known as Cow Pond meadows.

The ponds in the valley of Salmon brook are all small, but have been enlarged by dams so that they cover quite an extent of territory. The only good natural pond is Baddacook, the area of which is fourteen hundredths (.14) of a square mile.

The following table gives the elevation of the ponds draining into Salmon brook and Stony brook; also the distance of each from Lowell.

SALMON BROOK.		
	Elevation above City Datum.	Distance from W. End of Filter Gallery.
Merrimack River at Tyngsborough Bridge . .	34.29	6.0 miles.
Salmon Brook at Pleasant Street, Dunstable .	107.22	10.2 “
Lower Massapoag Pond . . . . .	107.49	10.7 “
Massapoag Pond . . . . .	117.14	11.2 “
Danforth’s Mill Pond . . . . .	133.48	12.5 “
Cow Pond . . . . .	144.44	10.0 “
Knops Pond . . . . .	164.79	10.5 “

STONY BROOK.		
Merrimack River at Stony Brook . . . . .	33.68	2.0 “
Leach’s Pond . . . . .	65.56	3.0 “
Nabnasset Pond . . . . .	115.10	5.5 “
Flushing Pond . . . . .	162.85	5.7 “
Sought For Pond . . . . .	145.90	6.2 “
Keyes’ Pond . . . . .	127.27	7.2 “
Wier at Beacon Street reservoir . . . . .	181.122	

The water in Salmon brook has quite a brown color, caused by standing in the boggy swamps above Cow Meadow pond. If this source was used as a water supply, these large swamps would have to be cleared of their vegetable deposit, or the water would have to be filtered before it could be used as a domestic water supply. Several samples of water taken from Salmon brook and its ponds have been analyzed, and the results will be found in the annexed table.

Respectfully submitted,  
(Signed.)  
GEORGE BOWERS, *City Engineer.*

Office of Inspector of Milk and Vinegar, City Hall, Lowell, Mass.

WATER ANALYSIS.

(PARTS IN 100,000.)

DATE OF Col- lec- tion.	APPEARANCE.			ODOR.		RESIDUE ON EVAPORATION.			AMMONIA.			Chlorine.	NITROGEN AS		Hardness.	Iron.	Oxygen Consumed.	REMARKS.
	Tur- bidity.	Sedl- ment.	Color.	Cold.	Hot.	Total.	Loss on Igni- tion.	Fixed.	Total.	In so- lution.	In sus- pension.		Ni- trates.	Ni- trates.				
March, 1895 11	None.	None.	....	.....	.....	6.52	3.24	3.28	.0126	.0160	....	.46	Trace	....	1.4	....	....	Salmon Brook.
May, 9 10	.....	.....	....	.....	.....	....	....	....	.0016	.0320	....	.42	None.	....	....	....	....	"
May, 9 10	.....	.....	....	.....	.....	....	....	....	.0028	.0344	....	.47	None.	....	....	....	....	Massapoag Pond.

ANALYSIS BY W. P. ATWOOD, CHEMIST, LOWELL, MASS.

April, 1895. P. M. 17 19	None.	Slight Brown.	0.7	Earthy.	.....	5.30	2.80	2.50	.0026	.0186	....	.24	.008	....	1.40	....	0.650	Salmon Brook at Pine Street, Nashua.
April, P. M. 18 19	None.	Slight Brown.	0.6	Earthy.	.....	4.50	1.50	3.00	.0016	.0158	....	.24	.012	....	1.60	....	0.012	Massapoag Pond.



LOWELL WATER WORKS OFFICE,  
January 1st, 1896.

TO THE LOWELL WATER BOARD:

*Gentlemen*:—Herewith I submit figures detailing the finances of the Lowell Water Works for the year ending December 31st, 1895.

J. W. CRAWFORD, *Clerk*.

TABLE I.

## FINANCIAL STATEMENT—LOWELL WATER WORKS, 1895.

		CHARGES.				RECEIPTS.				
		Water.		Other than Water.	Total Charges 1895.	Total Charges 1894.	By Accounts.			Due.
		Rate.	Metered.				Receipts.	Discounts.	Abatements.	
Transfer .....	.....	.....	.....	.....	\$28,181 95	\$28,231 87	\$24,913 28	\$ 2,204 26	\$ 195 37	\$ 869 04
January.....	\$ 62 07	.....	\$ 62 07	\$ 593 44	655 51	755 97	523 29	7 09	.....	125 13
February . . . .	.....	.....	.....	1,643 18	1,643 18	.....	1,566 74	65	10 75	65 04
March .....	109,216 49	\$22,973 58	132,190 07	.....	132,190 07	130,719 71	116,029 53	13,123 21	2,804 44	232 89
April.....	1,791 71	.....	1,791 71	2,475 70	4,267 41	2,917 47	3,642 15	177 57	97 23	350 46
May.....	2,510 96	.....	2,510 96	1,733 33	4,244 29	5,725 80	3,644 41	249 68	77 94	272 26
June .....	1,558 98	27,653 93	29,212 91	1,672 46	30,885 37	26,746 05	27,535 05	2,908 74	124 82	316 76
July .....	961 64	.....	961 64	1,698 38	2,660 02	3,236 19	2,262 88	99 83	44 50	252 81
August .....	724 79	62 27	787 06	3,791 57	4,578 63	1,953 59	3,761 18	75 74	.....	741 71
September.....	618 98	25,425 73	26,044 71	1,588 32	27,633 03	25,072 88	22,581 30	2,384 80	51 52	2,615 41
October .....	366 48	4 90	371 38	2,424 44	2,795 82	2,014 01	1,493 31	20 82	10 84	1,270 85
November.....	449 08	.....	449 08	1,909 50	2,358 58	3,492 58	367 37	10 47	11 58	1,969 16
December.....	578 00	23,472 04	24,050 04	794 52	24,844 56	22,893 50	1,268 25	86 64	.....	23,489 67
Totals. ....	\$118,839 18	\$99,592 45	\$218,431 63	\$20,324 84	\$266,938 42	\$253,759 62	\$209,588 74	\$21,349 50	\$3,428 99	\$32,571 19

LOWELL WATER WORKS OFFICE,  
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Rate.	Metered.	Total.	Receipts.				Discounts.	Abatements.	Due.	
Transfer .....	.....	.....	.....	.....	\$28,181 95	\$28,231 87	\$24,913 28	\$ 2,204 26	\$ 195 37	\$ 869 04
January.....	\$ 62 07	.....	\$ 62 07	\$ 593 44	655 51	755 97	523 29	7 09	.....	125 13
February .....	.....	.....	.....	1,643 18	1,643 18	.....	1,566 74	65	10 75	65 04
March .....	109,216 49	\$22,973 58	132,190 07	.....	132,190 07	130,719 71	116,029 53	13,123 21	2,804 44	232 89
April.....	1,791 71	.....	1,791 71	2,475 70	4,267 41	2,917 47	3,642 15	177 57	97 23	350 46
May.....	2,510 96	.....	2,510 96	1,733 33	4,244 29	5,725 80	3,644 41	249 68	77 94	272 26
June .....	1,558 98	27,653 93	29,212 91	1,672 46	30,885 37	26,746 05	27,535 05	2,908 74	124 82	316 76
July .....	961 64	.....	961 64	1,698 38	2,660 02	3,236 19	2,262 88	99 83	44 50	252 81
August ... ..	724 79	62 27	787 06	3,791 57	4,578 63	1,953 59	3,761 18	75 74	.....	741 71
September.....	618 98	25,425 73	26,044 71	1,588 32	27,633 03	25,072 88	22,581 30	2,384 80	51 52	2,615 41
October .....	366 48	4 90	371 38	2,424 44	2,795 82	2,014 01	1,493 31	20 82	10 84	1,270 85
November.....	449 08	.....	449 08	1,909 50	2,358 58	3,492 58	367 37	10 47	11 58	1,969 16
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Totals.....	\$118,839 18	\$99,592 45	\$218,431 63	\$20,324 84	\$266,938 42	\$253,759 62	\$209,588 74	\$21,349 50	\$3,428 99	\$32,571 19

TABLE II.

## FINANCIAL STATEMENT—LOWELL WATER WORKS, 1895.

## OUTGO.

	Pay Rolls and Salaries.	Water Works. Supplies.	Interest and prin- cipal.	Refunds and Va- cances.	General Expense Account.	Stable Dept.	Reser- voir Dept.	Morris Engine Repairs.	Recharged Sundry Persons.	Land.	Coul.		Driven Wells Pumping	Totals.	
											P. S. 1.	P. S. 2.		1895.	1894.
January .....	\$4,904 08	\$3,472 71	\$1,260 00	\$ 96 03	\$383 04	\$324 89	\$ 25 00	\$ 375 49	\$ 28 80	.....	\$2,215 89	.....	.....	\$13,175 93	\$5,697 98
February .....	2,960 63	2,081 53	7,295 00	.....	155 99	135 97	.....	16 33	12 65	.....	.....	.....	.....	12,658 10	13,752 31
March . . . . .	3,434 92	1,418 48	1,120 00	21 14	590 43	54 77	135 00	15 32	40 60	.....	.....	.....	.....	6,830 66	11,263 66
April .....	4,397 57	2,649 73	160 00	60 24	154 12	39 45	2 43	.....	13 85	.....	.....	\$1,291 80	.....	8,769 19	8,076 56
May .....	5,578 04	7,974 63	18,440 00	38 25	138 58	77 08	44 09	.....	164 95	.....	.....	1,684 55	.....	34,160 17	29,259 68
June . . . . .	5,358 11	3,499 03	2,640 00	31 77	211 05	754 20	2 25	.....	47 58	.....	1,481 09	.....	.....	14,025 08	17,516 07
July .....	4,389 20	4,788 55	5,000 00	1,407 18	362 24	108 64	86 40	.....	76 50	\$6,500 00	.....	.....	.....	22,718 71	10,888 08
August .....	5,724 13	5,223 09	2,355 00	41 62	534 79	288 37	.....	138 83	37 21	.....	.....	1,412 53	.....	15,755 57	9,249 09
September .....	4,732 64	3,336 47	720 00	9 42	258 54	148 70	.....	3 03	104 65	.....	714 67	284 87	.....	10,342 99	19,868 29
October .....	4,908 12	1,989 57	380 00	109 19	276 25	126 78	.....	1,179 66	238 07	.....	.....	900 33	.....	10,107 97	10,444 75
November .....	4,619 40	1,671 98	29,740 00	70 00	130 75	41 35	4 18	.....	4 35	.....	.....	97 76	.....	36,379 77	43,035 84
December .....	2,612 24	3,371 62	2,360 00	.....	163 06	214 95	2 10	.....	20 00	.....	.....	1,516 91	\$12,429 05	22,689 93	14,163 71
Totals .....	\$53,729 08	\$41,477 39	\$71,470 00	\$1,884 84	\$3,378 84	\$2,315 15	\$301 45	\$1,728 66	\$789 21	\$6,500 00	\$4,411 65	\$7,196 75	\$12,429 05	\$207,614 07	\$183,216 02

TABLE III.

FINANCIAL STATEMENT—LOWELL WATER WORKS, 1895.

SUBDIVISION OF "OTHER THAN WATER CHARGES" FROM TABLE I.

	Meters Sold.	Expense Setting Meters.	Meter Repairs.	New Services.	Rekind Services.	Labor and Material.	Lime Charges.	Shut off Fees.	Sewer Flush- ing.	Totals.	
										1895.	1894.
January.....	\$ 459 00	\$30 46	\$29 18	\$ 25 00	\$ 9 25	\$ 27 75	\$10 80	\$ 2 00	.....	\$ 593 44	\$ 651 44
February.....	747 00	48 22	51 57	21 00	7 13	745 84	6 42	4 00	\$12 00	1,643 18	.....
March.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
April.....	1,623 10	111 90	28 95	148 73	180 91	334 63	33 48	6 00	8 00	2,475 70	2,555 89
May.....	912 00	66 91	11 10	440 40	106 01	164 41	22 50	2 00	8 00	1,733 33	1,821 19
June.....	786 00	55 72	9 60	272 72	331 87	170 03	32 52	2 00	12 00	1,672 46	995 38
July.....	895 75	56 84	.....	434 08	152 87	94 26	56 58	2 00	6 00	1,698 38	1,880 14
August.....	1,236 50	60 60	.....	353 78	83 05	2,005 34	36 30	.....	16 00	3,791 57	1,671 30
September.....	604 50	38 09	5 25	419 82	117 61	311 79	79 26	.....	12 00	1,588 32	2,070 27
October.....	854 00	68 02	.....	344 60	126 70	973 66	53 46	.....	4 00	2,424 44	1,609 65
November.....	750 50	48 96	.....	276 89	217 14	482 01	54 00	68 00	12 00	1 909 50	3,283 67
December.....	99 00	6 31	.....	167 83	54 67	434 93	27 78	4 00	.....	794 52	2,081 81
Totals.....	\$8,967 35	\$592 03	\$135 65	\$2,904 85	\$1,387 21	\$5,744 65	\$413 10	\$90 00	\$90 00	\$20,324 84	\$18,620 74

TABLE IV.

FINANCIAL STATEMENT—LOWELL WATER WORKS, 1895.

SUBDIVISION OF "PAY ROLLS AND SALARIES" FROM TABLE II

	Salaries President Superin- tendent.	Office and Inspectors	New Meter Work.	Meter Repairs.	Extension and Construc'n	Pumping.		Maintenance.		Reser- voir.	New Services	Relaid Services	Recharg'd Sundry Persons.	Totals.	
						Station 1.	Station 2.	Old System	Wells.					1895.	1894.
January.....	\$183 33	\$798 00	\$ 25 00	\$157 50	\$1,248 36	\$683 99	\$428 23	\$1,112 18	\$ 58 00	\$61 49	\$ 50 00	\$ 17 25	\$170 75	\$4,894 08	\$2,914 16
February.....	183 34	638 40	24 50	160 50	108 36	477 25	335 89	796 88	177 00	46 04	.....	.....	12 47	2,960 63	2,319 05
March.....	183 33	716 06	54 50	140 00	112 20	546 61	457 17	1,050 63	54 62	57 53	8 00	16 75	37 50	3,434 92	4,933 06
April.....	183 33	559 96	109 37	41 63	748 25	272 28	345 64	1,599 42	72 30	57 04	138 17	183 30	86 88	4,397 57	3,843 02
May.....	183 34	570 96	71 25	103 90	1,593 58	230 67	345 64	1,595 42	269 99	56 60	233 20	174 24	85 25	5,578 04	3,965 19
June....	183 33	721 20	99 75	147 37	836 70	338 09	429 61	1,434 25	499 21	57 55	302 30	197 65	110 50	5,358 11	4,832 08
July.....	183 33	612 00	77 75	110 50	936 55	246 45	348 09	1,012 73	247 63	46 04	288 01	141 00	141 12	4,389 20	4,040 57
August.....	183 34	776 25	102 50	120 50	1,442 20	313 81	432 05	1,274 50	382 44	69 99	348 55	136 50	141 50	5,724 13	4,061 35
September....	183 33	631 00	75 00	92 00	999 59	288 44	344 09	1,117 52	441 28	46 04	271 35	135 50	106 50	4,752 64	4,903 78
October.....	177 40	561 83	87 00	90 75	1,226 46	226 92	345 89	1,226 51	99 14	46 04	212 90	193 90	413 38	4,908 12	4,381 02
November....	183 34	719 55	87 25	130 00	701 05	231 00	436 55	1,251 81	67 60	57 55	279 25	183 20	271 25	4,619 40	4,791 70
December.....	283 33	419 73	49 50	72 75	355 35	127 31	259 23	632 88	24 00	34 53	153 50	84 40	115 73	2,612 24	4,127 49
Totals.....	\$2,294 07	\$7,714 94	\$863 37	\$1,389 40	\$10,301 65	\$3,983 42	\$4,508 08	\$14,104 73	\$2,433 21	\$636 46	\$2,343 23	\$1,463 69	\$1,692 83	\$53,729 06	\$49,132 47

TABLE V.

*FINANCIAL STATEMENT—LOWELL WATER WORKS, 1895.*

**SUBDIVISION "WATER WORKS SUPPLIES"  
FROM TABLE II.**

Pumping Station, No. 1, supplies.....	\$ 934 99
Pumping Station, No. 2, supplies.....	5,586 72
Iron pipe and specials.....	7,732 66
Hydrants.....	1,439 68
Gates, valves, and brass fittings.....	4,181 19
Lead pipe, pig lead, and solder.....	3,916 32
Meters.....	9,175 97
Sidewalk and gate boxes.....	1,538 60
Miscellaneous stock.....	6,702 87
Tools.....	268 39
	<hr/>
Total.....	\$41,477 39



TABLE VI.

FINANCIAL STATEMENT—LOWELL WATER WORKS, 1895.

DETAIL OF "PRINCIPAL AND INTEREST"  
FROM TABLE II.

WATER LOAN BONDS :

Coupon No. 7, May, 1894,	106 @ 20.....	\$ 2,120 00
No. 8, Nov., 1894,	2 @ 20.....	40 00
No. 9, May, 1895,	990 @ 20.....	19,800 00
No. 10, Nov., 1895,	950 @ 20.....	19,000 00
High Service Loan.....		3,000 00

NOTES :

Lowell Inst. for Savings, 6 months....\$42,000	}	\$1,560 00
6 months.... 36,000		
1 year, \$80,000.....		3,200 00
1 year, \$50,000.....		1,750 00
		<hr/>
		\$50,470 00

PRINCIPAL PAYMENTS :

Engine Loan.....	\$ 6,000 00
Driven Wells Loan.....	10,000 00
Driven Wells Loan.....	5,000 00
	<hr/>
	\$21,000 00

TABLE VII.

FINANCIAL STATEMENT—LOWELL WATER WORKS, 1895.

DRIVEN WELLS ACCOUNT NO. 1.

January 1, 1895. Balance.....	\$74,574 48
Receipts from Water Works.....	12,459 10
	<hr/>
	\$87,033 58

EXPENDED :

Pay rolls.....	\$ 4,026 80
Paid Water Works for labor.....	553 51
Supplies.....	1,116 90
Telephone, advertising, and general ex- penses.....	675 66
Lead, iron pipe, and specials.....	17,799 65
Hydraulic Construction Co. on contract	29,623 50
Hydraulic Construction Co. on pumping water .....	12,429 05
	<hr/>
	66,225 07

Balance .....	\$20,808 51.
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## TABLE VIII.

*FINANCIAL STATEMENT—LOWELL WATER WORKS, 1895.***DRIVEN WELLS ACCOUNT NO. 2.**

July 1, 1895. Loan..... \$75,000 00

**EXPENDED:**

Pay roll..... \$ 6,809 27

Supplies ..... 453 80

Advertising and general expenses.... 456 45

Lead, iron pipe, and specials ..... 18,415 56

Land..... 3,630 00

B. F. Smith & Bro. on contract.... 6,730 85

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36,495 93

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Balance..... \$38,504 07

## TABLE IX.

*FINANCIAL STATEMENT—LOWELL WATER BOARD, 1895.***MAINTENANCE AND CONSTRUCTION STATEMENT.****MAINTENANCE.****PAID FOR LABOR:**

Office and Inspectors and Salaries.....	\$10,009 01
Pumping Station No. 1.....	3,983 42
Pumping Station No. 2.....	4,508 08
Meter Repairs.....	1,389 40
General Maintenance.....	16,537 94
Reservoir.....	636 46

**PAID FOR MATERIAL:**

Output as per stock books.....	4,715 40
Interest.....	50,470 00
General Expense.....	3,378 84
Stable Department .....	2,315 15
Reservoir....	301 45
Morris Engine Repairs.....	1,728 66
Tools.....	268 39
Supplies: Pumping Station No. 1.....	934 99
Supplies: Pumping Station No. 2.....	5,586 72
Coal: Pumping Station No. 1.....	4,411 65
Coal: Pumping Station No. 2 .....	7,198 75
Paid Driven Well Loans for Water.....	12,429 05
	<hr/>
	\$130,803 36

**CONSTRUCTION.****PAID FOR LABOR:**

Extension, construction, and new services.....	\$12,644 88
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**PAID FOR MATERIAL:**

Output as per stock books....	16,672 85
Land.....	6,500 00
Principal Payments ...	21,000 00
	<hr/>
	\$56,817 73

**WATER WORKS EXPENDITURES, 1895.**

Adams, Charles E.....	\$ 2,501 70
Adams & Co.....	3 75
Allen, Otis & Son.....	100 24
American Bolt Co.....	236 18
American Express Co.....	24 95
American Tool & Machine Co..	81 42
Ame & Co.....	13 56
Atwood, William P.....	15 00
Anniston Pipe & Foundry Co.	2,081 55
Averill, O. E.....	29 14
Bacheller, Dumas & Co.....	188 55
Barker, H. R. Mfg. Co.....	2,706 56
Bartlett & Dow.....	32 40
Ball, C. O.....	4 00
Bainford, Joseph.....	2 02
Belas, H. P.....	310 90
Beharrell, F. C.....	55
Bentley, Sarah A.....	3 46
Bennett & Conlon.....	90 83
Bennett, J. W.....	32 65
Bolton, T. M.....	74 55
Boston Engineers' Supply Co.....	448 70
Boston & Maine R. R.....	1,591 23
Bowers, J.....	87 50
Bowen, Merrill Co..	3 00
Bowers, George.....	29 52
Boott Cotton Mills.....	20 29
Boucher, John.....	4 00
Boutwell Bros.....	86 81
Brady, P. F.....	7 50
Braman, Dow & Co.....	247 86
<i>Amount carried forward.....</i>	<b>\$11,009 31</b>

<i>Amount brought forward</i> .....	\$11,009 31
Brogan, Hugh H.....	13 91
Brogan, John.....	8 55
Brown, Francis.....	1 35
Brown, Frank K.....	2 55
Brown, John A.....	9 56
Brennan, Miles F.....	31 55
Bryant, E. P.....	206 25
Buffalo Meter Co.....	6 50
Buff & Burger.....	159 25
Builders' Iron Foundry.....	703 18
Burnham & Davis.....	33 68
Cahill Bros.. ..	99 30
Campbell & Hanscom.....	100 18
Cambridge, F. W.....	80
Callahan & Sanborn.....	16 90
Callahan, P. H.....	1 00
Cawley, Edward.....	30 59
Carr, Charles.. ..	12 50
Cheney, C. J.....	2 50
Chesterton, A. W. & Co.....	172 41
Chapman Valve Mfg. Co.....	6 03
Church, H. C. & Son.....	1,232 34
City Appropriation Driven Wells.....	12,459 10
"        "        Public Buildings.....	361 59
"        "        Roads and Bridges.....	871 19
"        "        City Debt.....	21,000 00
Clifford, William.....	5 40
Coburn, C. B. & Co.....	159 97
Coburn, C. G.....	15
Coffey Bros.....	333 85
Conners Bros.....	156 00
Consumers' Brewing Co.....	6,500 00
Cox, Fayette Estate.....	3 08
<i>Amount carried forward</i> .....	<hr/> \$55,710 52

<i>Amount brought forward</i> .....	\$55,710 52
Conant & Co.....	15 50
Courier-Citizen Co.....	123 37
Costello & Co.....	1,771 02
Clapp, Charles.....	380 00
Crawford, J. W.....	104 77
Crowley, Jeremiah.....	14 85
Cross, John.....	12 00
Cull, Edward.....	4 50
Daigle, Francis.....	6 75
Daily News Co.....	26 94
Davis & Farnum Mfg. Co.....	17 25
Deane Steam Pump Co.....	281 70
Deane & Main.....	599 43
Derby & Morse.....	1 20
Donovan & Co.....	88 25
Donovan, J. C.....	64 00
Doherty Bros.....	5 28
Drury & Green.....	1,825 27
Douglass, Edmund W.....	14 18
Dumas & Co.....	139 32
Dunning, James R.....	220 00
Engineering News Publishing Co.....	49 60
Engineering Record.....	48 60
Farrell, Ann F. Estate.....	8 66
Farrell & Conaton.....	259 22
Fire & Water.....	3 00
Fitzgerald, J.....	75
Flood, L. J.....	75
Francis, J. B., Estate.....	16 17
French & Puffer.....	50
Frye, F. & Co.....	500 25
Foye, W. P.....	69 19
Franklin Engraving Co.....	101 50
<i>Amount carried forward</i> .....	<u>\$62,479 29</u>

<i>Amount brought forward</i> .....	\$62,479 29
Gage, Daniel .....	1,297 11
Garlock Packing Co.....	18 00
Gates, Josiah & Sons.....	7 74
Gerrish, Thomas G.....	5 85
Glidden, C. J.....	62 74
Gookin Bros.....	11 68
Goodale, M. A.....	50
Goodale, Frank C.....	4 53
Gordon, Nellie M.....	11 40
Girard, Henry C.....	239 13
Hall, Seth B.....	80 43
Hall, Alonzo.....	9 00
Hamilton, Silas .....	10 72
Hanson, C. H. & Co.....	94 13
Harrington, John H.....	7 09
Harmon, A. N.....	10 50
Hathaway, E. F.....	1 47
Herrick, M. F.....	3 00
Hills, Ellen S.....	21 60
Hill, F. B. & Co.....	75 00
Hobson, Charles H.....	11 40
Holmes, Mark Jr. & Son.....	1 00
Holtzer-Cabot Electric Co.....	1 50
Howard, E. Watson Clock Co.....	9 60
Howe, Brown & Co....	28 76
Howe Lumber Co.....	336 14
Horne, D. W. & Son.....	8,293 95
Huse, H. V.....	1 75
Hutchins, B. M. & M. E.....	7 06
Keavey, Michael .....	4 88
Kelley, William & Son.....	1 75
Kimball, L. S.....	1 25
Kittredge, A. L. & Co.....	1 35
<i>Amount carried forward</i> .....	\$73,101 30



<i>Amount brought forward</i> .....	\$73,101 30
Knapp, Charles L.....	2 00
Knapp, A. O.....	1 00
Lang, Bickford, Estate.....	9 75
Lawler, Thomas H.....	13 35
Lawrence, Alvin.....	5 00
Laughton, Abel H.....	5 85
Lead Lined Iron Pipe Co.....	207 99
Leonard & Ellis.....	127 58
Libbey, Oliver A.....	6 50
Livingston, Andrew.....	3 06
Livingston, William E.....	2,272 92
Locke, Jennie D.....	75
Lowell Axle Oil Co.....	25 00
“ Baptist Union.....	8 55
“ Daily Sun.....	42 74
“ Electric Light Corp.....	461 00
“ Gas Light Co.....	117 30
“ Iron Co.....	1 32
“ Machine Shop.....	84
“ & Suburban St. R. R. Co.....	51 00
Lothrop & Cunningham.....	2 50
Ludlow Valve Manufacturing Co.....	124 90
Lyon Platinum Pen Co.....	6 00
Lyons, D. F.....	2 00
Mfg. Oil Co.....	4 50
Marren, Arthur Q.....	7 20
Masury, Young & Co.....	22 95
Matthew Temperance Inst.....	2 70
Marion, J. S.....	28 00
Merrill, J. & Son.....	9 00
Merrimack House.....	153 70
Metropolitan Meter Co.....	82 00
Michigan Brass & Iron Works.....	1,344 00
<i>Amount carried forward</i> .....	<u>\$78,254 25</u>

<i>Amount brought forward</i> .....	\$78,254 25
Miller, C. K.....	82 50
Miller, A. P.....	11 25
Moran, Patrick, Estate.....	1 00
Morrison, W. A.....	90
Molloy, Ann.....	8 00
Morning Mail Co.....	173 37
Murphy & Bingham.....	82 00
Mussen, John.....	5 00
McDonald, T. J.....	231 28
McCluskey, John.....	8 75
McElholm, James F.....	137 00
National Meter Co.....	8,688 55
N. E. Gamewell Co.....	30 00
N. E. Tel. & Tel. Co.....	471 78
N. Y. & Boston Despatch Express.....	11 45
N. Y., N. H. & H. R. R.....	2 30
Neff, Robert W.....	6 00
Neptune Meter Co.....	184 96
Nichols, A. F.....	819 47
Nichols, William & Co.....	10 90
O'Donnell, J. E.....	47 00
O'Connell, Julia.....	2 70
O'Flahavan, Michael.....	3 00
O'Sullivan Bros.....	57 30
Park, Robert, Estate.....	4 73
Patten & Co.....	25 00
Peat Valve Co.....	964 80
Perrin, Seamans & Co.....	263 41
Prince, G. C. & Son.....	11 35
Prop. Locks & Canals.....	220 20
Pratt, Amasa & Co.....	6 50
Post & Gardner.....	65
Putnam, F. E.....	13 75
<i>Amount carried forward</i> .....	<u>\$90,836 05</u>

<i>Amount brought forward</i> .....	\$90,836 05
Quinn, Felix, Estate.....	11 20
Quinn, Hugh, Estate.....	80
Quinn, J. P.....	5 00
Radford Pipe & Foundry Co.....	7 69
Railroad National Bank.....	5 00
Reading Foundry Co. Lim.....	15 48
Rensselaer Mfg. Co .....	203 25
Reynolds, Henry.....	87 95
Rice & Co.....	1 25
Richardson's Hotel.....	138 90
Rix, George W.....	13 54
Sanboru, A. H. & Co.....	8 00
Sanborn, G. J.....	3 25
Sawyer Carriage Co.....	204 55
Scannell & Wholey.....	2,630 50
Shedd Bros.....	28 28
Shedd, Freeman B.....	34 70
Sherman, E. S. & Co .....	23 13
Sherman, Dr. W. A.....	11 50
Shattuck, Horace B.....	17 52
Severance, J. L....	2 85
Smith, E. A. & T.....	54 50
Smith, Joseph W., Estate.....	3 00
Smith, Jesse, Heirs.....	5 00
Smith, Anthony P.....	129 00
Somes, William E.....	10 80
Spalding, William H. & Co.....	30 63
Sparks, J. H.....	124 50
Star Brass Mfg. Co.....	4 30
Staples Bros.....	1,557 27
Stanley, George E.....	6 50
Stevens, William F.....	20 00
Stevens, Harriet P.....	8 55
<i>Amount carried forward</i> .....	<hr/> \$96,244 44

<i>Amount brought forward</i> .....	\$96,244 44
Stoughton, E. E.....	1 00
Swift, John B.....	8 00
Talbot Dyewood & Chemical Co.....	24 71
Taylor, C. I. & Co.....	22 25
Thomas, R. J.....	64 45
Thompson Hardware Co.....	169 75
Thompson & Hill.....	21 00
Thomson Meter Co.....	128 35
Tilton & Co.....	10 09
Town of Chelmsford.....	59 85
Union Brass Foundry.....	104 10
U. S. Metallic Packing Co.....	137 68
Vacuum Oil Co.....	90 94
Vigeant, Paul.....	226 80
Vox Populi Press.....	362 75
Walworth Mfg. Co.....	61 68
Ward, S. L.....	7 02
Water & Gas Review Publishing Co.....	5 00
Webster, Caroline W.....	5 40
Webster, F. S. & Co.....	2 00
Western Union Telegraph Co.....	8 98
Whaley, Dennis.....	1 80
Wheelock Engine Co.....	1,179 66
White Bros. & Co.....	3 00
Whiting, Phineas.....	16 50
Wilder, H. H. & Co.....	1 90
Wilkinson, A. J. & Co.....	3 20
Wood, E. N. & Co.....	44 00
Wood, R. D. & Co.....	3,233 67
Worthen, George W., Estate.....	2 10
Worthington, Henry R.....	1 20
Wotton, Isaac.....	3 00
Young, Charles H.....	5 40
Zimmer, C.....	60
	<hr/>
	\$102,262 27

**SUNDRY BILLS PAID ON DRIVEN WELLS,  
ACCOUNT NO. 1.**

Allen, Otis & Son .....	\$ 9 45
Barker Mfg. Co. ....	63 05
B. & M. R. R. ....	2,713 49
Bowers, George. ....	7 56
Builders' Iron Foundry .....	1,251 68
Burnham & Davis. ....	4 48
City Appro. Public Bldgs. ....	1 16
"    "    Fire Dept. ....	10 00
"    "    Roads & Bridges. ....	300 00
Coburn, C. B. & Co. ....	13 72
Connors Bros. ....	130 50
Costello & Co. ....	28 96
City Appro. Water Works. ....	553 51
Davis & Sargent. ....	4 48
Deane & Main. ....	30 00
Drury & Green. ....	287 51
Hydraulic Construction Co. ....	42,164 58
Lawler, Thomas H. ....	2 05
Lowell Gas Light Co. ....	13 50
McNeil Pipe & Foundry Co. ....	14,459 29
Murphy & Bingham. ....	50 00
N. E. Tel. & Tel. Co. ....	75 60
N. Y., N. H., & Hartford R. R. ....	2 50
Peet Valve Co. ....	36 00
Perrin, Seamans & Co. ....	2 50
Pittsburgh Testing Laboratory, Lim. ....	131 15
Ramsey, T. A. ....	31 50
Parks, J. H. ....	5 00
Spalding Print Paper Co. ....	1 50
Simpson, John A. ....	13 50
Thompson Hardware Co. ....	22 35
Thomas, R. J. ....	9 65
Whipple, J. R. & Co. ....	68 15
	<hr/>
	<b>\$ 62,498 27</b>

## DRIVEN WELLS ACCOUNT NO. 2.

Atwood, William P.....	\$ 40 00
American Bolt Co.....	2 25
Averill, C. E.....	2 50
Beals, Horace F.....	228 61
Boulger & McOsker.....	30 00
Burnham & Davis.....	67 42
Bryant, E. P.....	5 80
Campbell & Hanscom.....	1 87
Chattanooga Foundry & Pipe Works.....	16,979 96
City Appro. Roads & Bridges.....	300 00
Courier-Citizen Co.....	6 00
Daily News Co.....	6 38
Davis & Farnum Mfg. Co.....	179 91
Engineering News Pub. Co.....	12 00
Engineering Record.....	12 20
Fire & Water.....	9 00
Girard, H. C.....	42 19
Hanson, C. H. & Co.....	150 75
Howe, Edward S.....	2,190 00
Holmes, Mark Jr. & Son.....	16 50
Howe Lumber Co.....	5 44
Lowell Daily Sun.....	7 50
Lowell Gas Light Co.....	4 50
O'Sullivan Bros.....	9 00
Pittsburg Testing Laboratory.....	193 25
Scannell & Wholey.....	4 60
Smith, B. F. & Co.....	6,730 85
Stanley, G. E.....	210 75
Thompson Hardware Co.....	34 99
Underwood, Thomas J.....	1,440 00
Walworth Mfg. Co.....	1,062 44
	<hr/>
	\$ 29,986 66

# REPORT OF SUPERINTENDENT.

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LOWELL, MASS., Jan. 1, 1896.

TO THE LOWELL WATER BOARD:

*Gentlemen:* I herewith present you the Annual Report of the Superintendent of Water Works for the year ending December 31, 1895.

By this report you will notice that the work of the department, which has in the last few years grown rapidly, is still very much greater the past year, and consequently the duties of the department officials have correspondingly increased in importance and responsibility.

The changing of the source of supply from the Merrimack river to driven wells has, of necessity, entailed a large amount of extra labor in the pumping and distribution of this water. Large new mains had to be laid; pipe heretofore sufficiently large, but now entirely inadequate to the new conditions, was replaced by pipe of very much greater capacity. Adding to this the unusual amount of street mains called for, and it will be understood why the demands of the department are far in

excess of what they were in previous years, and will in itself afford a satisfactory explanation of the increase in expenditures over former years.

CONSTRUCTION. FORCE MAIN TO HYDRAULIC CO.'S WELL PLANT.

One of the first pieces of construction during the year was the laying of a twenty-inch force main from the Cook plant (or Lower Wells plant) to the Hydraulic Co.'s plant (or Upper Well plant). This pipe was laid in severe winter weather last February and March, and was done very economically then, owing to the absence of water and the advantage of having the meadow, through which the pipe was laid, frozen hard, thereby enabling the department to handle the heavy material used with less labor than if the ground was wet and soft, as it would undoubtedly have been at any other time of the year. The material used was 5,277 feet of 20-inch pipe, one 12-inch gate for blow-off at Cook wells, 24 feet of 12-inch pipe on blow-off, one 20-inch gate, two 6-inch hydrants, one at each station, 12 feet of 6-inch pipe and two 6-inch gates for hydrants, 12 feet of 12-inch curves to pumps at hydraulic station. Specials: one 30 x 30 x 30 Y, one 30 x 20 reducer, two 20 x 20 x 6 tees, one 20 x 20 x 12 tee, one 20 x 20 x 8 tee, one 20 x 20 x 10 tee, and two 20 x 20 x 12 Y's. A 20-inch Venturi meter was set in this line near the Hydraulic Co.'s station for the purpose of metering



the water pumped under contract. The water was first pumped through this line April 5, and since then, as usual with work done by this department, no repairs of any kind have been necessary.

#### THE BOULEVARD FORCE MAIN.

The largest piece of construction of the year was the laying of the 24-inch pipe connecting the filter gallery with the new well plant at the head of the Boulevard, a distance of about 8,307 feet. This work was begun November 1, and practically all the pipe was laid December 31, the weather being in our favor to almost as great an extent as it was in laying the force main for the Hydraulic Co. The material used in completing this work was 8,307 feet of 20-inch pipe, three 24-inch curves, and two 24-inch x 24-inch x 20-inch manholes. The pipe laid was light pipe, weighing about 200 pounds to the foot.

#### EXTENSIONS.

During the year more cast iron pipe has been laid for street distribution than was laid in any one year for the last twenty years, viz: 29,086 feet. Of this amount, 3,186 feet was replacing smaller pipe on Cambridge and Wilder Streets. The work done on these two streets, of which this replacing was only a part, was done to relieve the pumps at the wells from excessive pressure due to friction in forcing water through too small mains; and in Wilder Street consisted of laying a 12-inch main

from Parker Street to Westford Street, and in Cambridge Street a 10-inch main from Tanner to Chelmsford Street. By adding the 20-inch pipe laid to the Hydraulic Co.'s station, the 24-inch pipe laid on the Boulevard, and the extensions for the year, the total amount of pipe laid in 1895 was 42,670 feet, or over eight miles. Further information regarding size of pipes, and streets through which extensions have been made, is contained in schedule accompanying this report.

#### HYDRANTS.

About the usual number (40) hydrants was set during the year, several flush hydrants were changed for post hydrants, and 50 hydrants were repaired, 7 of which were found broken. It has been the endeavor of the department to prevent unauthorized persons from using hydrants. Hydrants are intended for fire protection and should not be used except in case of fire, unless operated by an employee of this department who understands their working and who would be sure to leave the hydrant, when through, in good condition and available in case of fire.

#### GATES.

In the early years of the Water Works construction, there were not enough of gates set on street mains, so as a consequence, when the Water is shut off for any purpose, a large section of the city, including a number of streets, are without water; now it is the custom to place gates so that but one

street or as small a section as possible will be deprived of water, thereby lessening the danger from lack of water in case of fire, as well as causing inconvenience to a less number of people.

76 new stop gates were set during the year.

#### FIRE SERVICES.

Fire Services were laid during the year as follows:

Tremont & Suffolk storehouse, 10-inch pipe off Cabot Street.

White Bros. Tannery, Perry Street, 6-inch pipe.

Bagshaw's Mill, 6-inch pipe off Wilson Street.

Nesmith's Mill, 4-inch pipe, Howe Street.

Stirling Mills, 6-inch pipe, Lawrence Street.

The fire service in the yard of the Stirling mills was extended to their new mill, a new gate with indicator post set, and fire hydrant moved, all at their expense.

#### SERVICES.

349 new services were laid during the year, which is considerable more than was laid in any single year for several years past, this increase in the number of new services indicates an increase in the number of new buildings erected and consequent growth of the city.

In consequence of the old iron services becoming filled with rust so as to prevent a sufficient supply of water passing through them, 201 were changed for lead pipe.

The trouble with iron services breaking off at the sidewalk cocks, owing to galvanic action between the brass cocks and iron pipe has been more frequent

the past year than usual; cases of this kind as a rule occurred where they have been using the well water the longest, probably this water may have had the effect of removing the rust, which in a great many instances is all that holds the service pipe together.

## NEW SERVICES.

98	5-8-inch Lead Pipe	.	.	.	.	3,277 feet.
235	3-4-inch Lead Pipe	.	.	.	.	9,094 "
9	1-inch Lead Pipe	.	.	.	.	243 "
1	2-inch Lead Pipe	.	.	.	.	35 "
2	3-4-inch Lead Lined Iron Pipe	.	.	.	.	161 "
3	2-inch Iron Pipe	.	.	.	.	97 "
<hr/>						
349	Total laid in 1895	.	.	.	.	12,962 feet.
	Amount previously laid	.	.	.	.	361,849 "
<hr/>						
	Total now laid	.	.	.	.	374,811 feet.
	Total services laid	.	.	.	.	10,212
	Total cut off at main	.	.	.	.	569
	Total reconnected	.	.	.	.	43
	Total now in use	.	.	.	.	9,686

## SERVICES CHANGED.

No.	Kind.	CHANGED TO						Total.
		Lead ¾-in.	Lead ¾-in.	Lead 1-in.	Lead 2-in.	Lead 1-in.	Lead ¾-in.	
170	¾-in. iron.	5,603	....	....	....	....	....	5,603
15	¾-in. iron.	.....	423	....	....	....	....	423
13	¾-in. iron.	.....	....	277	....	....	....	277
1	1½-in. iron.	.....	....	....	16	....	....	16
1	1-in. iron.	.....	....	....	....	20	....	20
1	⅝-inch lead.	.....	....	....	....	....	36	36
<hr/>								
201	Total,	5,603	423	277	16	20	36	6,375

## METERS.

In no previous year has the number of new meters set equaled the past year, which was 350, making in all 3,174 meters in use Dec. 31, 1895. The rule of testing every meter before setting and keeping a record of the same has been strictly adhered to, and in no case has a meter been set that was found in error over 3 per cent. The method employed in testing meters is called the "bench test," and consists, as you know, of weighing the water after it has passed through the meter into a tank, and comparing the weight with the amount registered by the meter. This tank is set on Howe scales, and has a capacity of 100 cubic feet. The water is drawn from the meter through various sized openings, according to the size of the meter, and down as fine as a 32nd of an inch. It should be understood that this test does not determine the merits of a meter; it is simply a precaution to guard against the setting of a meter that registers wrong in the start, and in order to have a record for future comparison. Experience has taught this department that the only thorough test of the merits of a meter is actual use for a number of years; also, that the failure of one meter of a certain manufacture should not condemn all meters of that make; it is only by averaging the results of a number of meters of the same kind that a fair estimate can be arrived at as to their comparative worth.

**METERS RUNNING DECEMBER 31, 1895.**

Size in inches....	$\frac{1}{8}$ -in.	$\frac{1}{4}$ -in.	1-in.	$1\frac{1}{8}$ -in.	2-in.	3-in.	4-in.	6-in.	Total.
Desper.....	172	62	20	...	...	...	...	...	254
Worthington..	246	23	46	69	33	8	3	...	428
Crown.....	976	1,110	230	8	11	2	5	1	2,343
Duplex.....	9	11	9	...	...	...	...	...	29
Ball & Fitts...	5	...	...	...	...	...	...	...	5
Fitts Rotary ..	1	1	...	...	...	...	...	...	2
Frost.....	19	8	3	...	...	...	...	...	30
Thomson.....	1	18	2	...	...	...	...	...	21
Gem.....	...	...	...	...	5	...	1	1	7
Hersey.....	12	21	3	...	...	...	...	...	36
Weir.....	...	1	...	...	...	...	...	...	1
Metropolitan..	...	2	...	...	...	...	...	...	2
Trident.....	5	9	1	...	...	...	...	...	15
Nash.....	...	1	...	...	...	...	...	...	1
<b>Total.....</b>	<b>1,446</b>	<b>1,267</b>	<b>314</b>	<b>77</b>	<b>49</b>	<b>10</b>	<b>9</b>	<b>2</b>	<b>3,174</b>

New meters set..... 350  
 Meters repaired..... 650  
 Meters condemned..... 84  
 Meters condemned and replaced with new..... 98  
 Meters frozen and burst..... 39

**PRIVATE METERS RUNNING JAN. 1, 1896.**

Size .....	$\frac{3}{8}$ -in.	$\frac{1}{2}$ -in.	$\frac{3}{4}$ -in.	1-in.	2-in.	Total.
Desper .....	...	1	3	1	...	5
Worthington .....	...	...	...	1	2	3
Crown .....	1	22	19	1	...	43
Duplex.....	...	1	...	...	...	1
Frost.....	...	2	1	...	...	3
Thomson.....	...	...	1	...	...	1
Hersey.....	...	1	...	...	...	1
Nash.....	...	1	...	...	...	1
Total.....	1	28	24	3	2	58

**MAINTENANCE.**

It is next to impossible to give an adequate idea of the amount of work involved in the care and maintenance of a large Water Works system. Every branch of the service requires more or less special attention.

**FILTER GALLERY, INLET, AND CONDUIT.**

The filter inlet, while in use during the year, was cleaned monthly, except in the winter months when it was covered with ice.

The frequent cleanings, which consist of scraping a quarter of an inch of the surface each time, have resulted in the removal of practically all the sand which constitutes the top layer; but before renewing it, the other different layers of gravel, etc., which have been in use for twenty years, should be

overhauled, as they also may have to be replaced by new material.

Samples of water taken after having passed this filter have been examined for bacteria and found to contain 97 per cent. less than the same water before filtration; and this notwithstanding the poor condition of the filter.

Owing to the yield of water from the wells being sufficient to supply the city in November and for the most part of December, it was thought best to draw the water off the filter inlet and expose the surface to the action of the air and sun, and this was accordingly done. An inspection of the floor of the filter inlet house revealed the fact that it was so badly decayed as to be dangerous, and was replaced by a new floor and floor beams; the house was also given two coats of paint. The gate house on the river inlet also had a new floor and floor beams laid and the walls whitewashed. No repairs were found necessary on the gallery or conduit.

#### PUMPING STATIONS.

Pumping Station No. 1, on West Sixth Street, got along with having the pump wells cleaned occasionally, the engines, boilers, etc., being in good condition. All of the pumps at this station have been run more or less during the year. The work of rebuilding the Morris engine having been completed, the engine is now capable of doing good service.



Pumping Station No. 2. This station, which is otherwise known as the Cook Wells plant, has come in for considerable outlay. The new 200-horse-power boilers, which were furnished by Scannell & Wholey, under contract with the Board, have been running satisfactorily since they were set last June. In order to give the men more room for cleaning fires and handling coal, the boiler room was enlarged by extending the side in front of the boilers out ten feet. The coal bin was rebuilt so that it will now hold 1000 tons of coal; the smoke stack was given two coats of black paint known as boiler black. A new boiler feed pump of the Deane make has been set up in the engine room, taking the place of a small Worthington pump, which did duty for the department since 1872.

The two large Deane pumps at this station continue to do good service, although requiring a great deal of repairing. Especially is this true of the water ends, the piston rings, heads, and water valves causing frequent trouble.

#### NEW WELLS ADDED.

In accordance with your instructions, the group of seven wells known as the Andrews wells, together with twelve 2-inch wells constructed by the department, have been connected with this plant, making nineteen additional wells.

In connection with this work patterns were made and a first-class machine built at the department shop for the purpose of driving wells, so that the

department is now well equipped for future work of this kind. The suction pipe for these wells is 953 feet long of 10-inch cast iron pipe, with flange joints, and was laid 8 feet below the old suction, this being in accordance with the plan of lowering the whole plant eight feet, as per vote of your honorable Board.

Following out this plan, the Island line was lowered eight feet and was begun on another line when the water in the brook rose too high for further work in that direction. All arrangements, however, are made, material bought, etc., to complete these improvements when the level of the brook will permit.

#### PUMPING.

The total pumpage of water for the year was 2,527,811,749 gallons; of this quantity 1,710,882,629 gallons was Well water, the balance 816,929,120 gallons was supplied from the Merrimack river, 75 per cent. of the river water having passed through the filter. These figures for pumping, which are practically the same for consumption, show an average of 6,922,092 gallons per day, or 80 gallons per inhabitant per day, which, although not as large as a great many cities in this country, are still in excess of what they should be and indicate an immense waste of water. Take, for example, the daily average for the month of February, 8,318,300 gallons, compared with the daily average for the month of April, which was 6,034,913 gallons, showing an excess of

over two and one quarter million gallons consumed every day in February, due to the running of water to prevent freezing. This extreme waste of water is a serious matter, for it is not only a gross waste of a valuable commodity, but forces upon the city and consequently the people, the necessity of incurring vast expenditures of money to procure an additional supply from time to time. Again, this unrestricted running of water creates a draft on the mains, so that the pressure at the fire hydrants is insufficient for fire purposes and in the event of a large fire some day, the result will be disastrous.

As will be seen by the preceding figures on pumping, the efforts of the Board to provide better water has had the effect, through the medium of the Hydraulic Well Co.'s plant, of materially increasing the proportion of Well water consumed during the year, and thereby decreasing the amount of unfiltered river water needed. One of the most gratifying results of this improvement in the water supplied is its beneficial effect on the public health. Since the introduction of Well water, according to figures kindly furnished by Agent Knapp of the Board of Health, the death rate from typhoid fever has been steadily declining and that during the past year only thirty-three deaths have occurred from this disease, this being the lowest in fifteen years. These figures present another phase of the water waste evil, the moral of which is: the less water is wasted the less river water is used, and consequently the less typhoid

fever; while the more water is wasted, the more river water and the greater the risk from typhoid fever and kindred diseases.

I sincerely believe that the City Council can do nothing this year that will be a greater benefit to the city than by adopting legislation looking to the prevention of this useless and unnecessary waste of water and its resultant evils.

#### MISCELLANEOUS.

2,376 feet of 6-inch pipe was laid in the Edson cemetery and a 6-inch meter set on the same, also, two 6-inch gates, the Department of Cemeteries bearing the expense

With a view of laying a 12-inch pipe across the new Moody street bridge, openings were left in the abutments, and the truss work will also have attachments for carrying the pipe. To do this work properly, the 12-inch pipe at the head of Merrimack street should be extended through Pawtucket street to Moody street, across the bridge, through new Moody street as far as Riverside street.

At present Pawtucketville depends on an 8-inch main crossing Pawtucket bridge for its supply, so that this proposed 12-inch main cannot fail to be a great benefit to the people and property in that section.

The blacksmith's forge, which occupied a place in the basement of the present Water Works shop, has been moved into the old shop near the boiler room,

the objection to having it in the basement of the new shop was that when starting the fire it smoked the whole building; it was also inconvenient to get to, whereas it is now in an independent building and level with the ground, so that horses can be brought in there and shod in case the department decides to do its own horse shoeing.

The lumber used in timbering the force main ditch on the Boulevard will be hauled to the Cook well plant, so that it can be used there for the same purpose, when the work of lowering the suction pipe shall be resumed.

The lowering of the grade of Lawrence street beyond the Lowell Cemetery, consequent upon the abolition of the grade crossing there, has compelled the department to remove the water pipe from the street and lay a temporary pipe through private land to supply water to the people living on Billerica street and the further end of Lawrence street. Several hundred feet of 12-inch pipe on Thorndike street was taken up and relaid in order to make way for the new sewer through that street.

Considerable other miscellaneous work was done during the year, such as the setting of a new drinking fountain at Monument Square, the changing of the stone watering troughs at the junction of Chelmsford and Powell streets and Davis Corner for cast iron fountains, the relocation of the fountain on Bridge street near First street, the cleaning and repairing of fountains, repairing leaks, removing flush

hydrant boxes, replacing wooden service boxes with iron boxes, and various other jobs too numerous to mention.

In closing, I desire to express my gratitude to President Putnam, Ex-President Brennan, Members of the Water Board, Clerk Crawford and his predecessor, Charles L. Knapp, for kind assistance and hearty co-operation during the year.

Respectfully submitted,

ROBERT J. THOMAS,

*Superintendent.*

LOW SERVICE.—WATER PIPES LAID IN 1895.

STREETS.	BETWEEN WHAT STREETS.	Length in feet.						Total.
		4-in.	6-in.	8-in.	10-in.	12-in.	20-in.	24-in.
Agawam.....	Southerly to St. James .....		264					264
Arch... ..	Easterly from Howard .....		274					274
Anderson.....	Extended easterly.....		47					47
B .....	Easterly and west'ly from Puffer		483					483
Bagshaw.....	Fire service off Wilson.....		205					205
Beacon .....	Southerly from Methuen .....		299					299
Bellevue.....	Extended southerly.....			191				191
Bennett. ....	Vernon and Beacon .....		232					232
Blossom .....	Extended westerly.....		180					180
B. & M. R. R....	Standpipe westerly from Mead- owcroft .....		525					525
Bradley.....	Extended northerly .....		493					493
Broadway.....	Extended westerly.....		62					62
Burlington Ave.	Southerly from Marginal.....		145					145
Burnside.....	Extended southerly. ....		110					110
C.....	Easterly from Puffer .....		197					197
Cambridge .....	Chelmsford and Tanners.....				1658			1658
Charles Ave ....	Northerly from Woodcock ..		143					143
Christian .....	Reservoir and Bradley.....		1094					1094
Claire .....	Northerly from Broadway.....			234				234
Coburn.....	Southerly from Hildreth .....		36½					36½
Consum'rs R.Co.	Service .....	24	324					348
Cornell.....	Southerly from Middlesex .....		568½					568½
Crawford .....	Extended northerly .....		107					107
Dalton .....	Northerly to Farmland Rd .....		247					247
Daly .....	Easterly to Grand .....		190					190
Doane.....	Easterly from Chelmsford .....		267					267
Dunphy.....	Extended northerly .....		55					55
Durkee Rd .....	Southerly from Varnum Ave....		420					420
E. ....	Westerly from School .....		86					86
	Carried forward .....	24	7054	425	1658			9161

LOW SERVICE.—WATER PIPES LAID IN 1895.—*Continued.*

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## LOW SERVICE.—WATER PIPES LAID IN 1895

STREETS.	BETWEEN WHAT STREETS.	4-in.	6-in.	8-in.	10-in.	12-in.	20-in.	24-in.	Total.
	<i>Brought forward</i> .....	119½	12020	700	1650				15207½
Plymouth.....	Southerly from Riverside.....		149						149
Princeton.....	Westerly from Pine.....				62				62
Prospect.....	Westerly from Kidder.....		94						94
Reed's Ct. ....	Northerly from Lakeview Ave..	114							114
Reservoir.....	Beacon and Christian.....		890						890
Richmond.....	Easterly from Central.....		151						151
Roberts.....			421						421
Sayles.....	Extended northerly.....		371						371
School.....	Extended southerly.....		49						49
Shaw.....	Extended westerly.....		51						51
Sheldon.....	Extended westerly.....		66						66
Short.....	Southerly from Chelmsford.....		427						427
Sixth Ave.....	Westerly from Roberts.....		122						122
Sixth Ave.....	Westerly from Dunphy.....		136						136
So. Canton.....	Extended northerly.....		24						24
St. James.....	Easterly and westerly from Agawan.....		177						177
Stackpole.....	Extended easterly.....		60						60
Stevens.....	West Forrest and Jenness.....			514					514
Sterling Mills..	Fire service.....		95						95
Suttle.....	Easterly from Carlisle..		96						96
Tanners.....	At Howard.....		12						12
Tolman Ave....	Westerly from Mammoth Rd....			713					713
Tremont & Suffolk Mill.....	Northerly from Tucker to store- house. (Taken out Dec., 1896.)		305						305
Tremont & Suffolk Mill.....	Fire service Cabot St. storehouse				187				187
Tucker.....	Northerly from Hall.....		204						204
Twelfth.....	Easterly to May.....		83						83
Upham.....	Westerly from Chelmsford.....		172½						172½
Upham.....	Southerly from Coburn Lane...		126						126
Victoria.....	Westerly from Chelmsford..		196						196
Waite.....	Chelmsford and Frye.....		230						230
	<i>Carried forward</i> .....	233½	17541½	1927	1907				21609

LOW SERVICE.—WATER PIPES LAID IN 1895.—*Continued.*

Length in feet.	i
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### HIGH SERVICE—WATER PIPES LAID IN 1895.






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Brought forward .....	87,049.0
Low Service laid previous to 1895 .....	533,796.8
Total Low Service to Jan. 1, 1896 .....	570,845.8
Total High Service to Jan. 1, 1896 .....	34,371.8
Total High and Low Service to Jan. 1, 1896 .....	605,216.8
Total in miles, 114.62.	

**LOW SERVICE—LIST OF STOP GATES SET DURING THE  
YEAR 1895.**

LOW SERVICE—LIST OF STOP GATES SET DURING 1895.—*Continued.*

STREETS.	LOCATION.	4-in.	6-in.	8-in.	10-in.	12-in.	20-in.	34-in.
Durkee Rd.....	10 ft. line  Durkee Rd., on south line E, 1 ft. west of west line School Street.....	1						
E.....	line E, 1 ft. west of west line School Street.....	1						
E. Richardson.....	North line E. Richardson, on east line.....	1						
Fifth Ave.....	Fifth Ave., on west line.....	1						
Foster.....	13 ft.  Foster, 1 ft. south of street.....		1					
Foundry.....	7 ft. north of south line Foundry, 2 ft. east of east line Main Street.....	1						
Frye.....	13 ft. east of west line Frye, on south line.....	1						
Glidden Ave.....	 line Glidden Ave., on north line.....		1					
Glidden Ave.....	Glidden Ave., on south line.....		1					
Hale.....	 line Hale, 2 1/2 ft. east of Street.....	1						
Hale.....	13 ft. east line Hale, 19 ft. west of Street.....	1						
Hovey.....	173 ft. east of line.....	1						
Howard.....	12 ft. east of south of line Howard, and 31 feet Building....	1						
Howe.....	On fire service to Nesmith's mill.....	1						
Lamb.....	14 1/2 ft. east of west line Lamb, 1 ft. north of north line Eighth Avenue.....	1						
L. L. & H. R. B.....	6 ft. west of east line Bradley, on fire service to car sheds.....	1						
Ludlam.....	line Ludlam, on south line.....	1						
Meadowcroft.....	3 1/2 ft. line.....	1						
McGovern's Ct.....	Court, on north line.....	1						
Midland.....	line Midland, on east line.....	1						
Montreal.....	12.3 of line Montreal, 5 ft. west of line.....	1						
Newell.....	 line Newell, on east line Chelmsford Street.....	1						
Newhall.....	23 line Newhall, on east line.....		1					
Nicollette.....	12 ft. south of north line Nicollette, 3 ft. east of east line Harvard Street.....	1						

LOW SERVICE.—LIST OF STOP GATES SET DURING 1895.—*Continued.*

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LOW SERVICE.—LIST OF STOP GATES SET DURING 1895.—*Continued.*

		<	5
Winthrop .....	8	0	
		1	
Wood .....	12		
		3	
<hr/>			

**LOW SERVICE.—LIST OF HYDRANTS SET DURING  
THE YEAR 1895.**

STREETS.	LOCATION.
Arch .....	Southerly side, 249 ft. east of Howard Street.
Bagshaw.....	In mill yard, 76 ft. south of Wilson Street.
Beacon .....	Westerly side, 12 ft. south of Methuen Street.
Bellevue.....	Westerly side, opp. Sheldon Street.
Bradley.....	Easterly side, rear L. L. & H. R. R. car sheds.
Broadway .....	Northerly side, on terminus.
Burnside .....	Easterly side, south of Middlesex Street.
C .....	Southerly side, 4 ft. east of Puffer Street.
Cabot .....	Northerly side, at Tremont & Suffolk storehouse.
Cambridge .....	Westerly side (replaced flush hydrant).
Consumer's B. Co....	North of building, 202 ft. west of Payton Street.
Dalton ... ..	Easterly side, 205 ft. north of Hovey Street.
Durkee Rd.....	Northerly side, 383 ft. south of Varnum Avenue.
Farmland Rd.....	Southerly side, 212 ft. west of Dalton Street.
Foster.....	Easterly side, 638 ft. south of Middlesex Street.
Foster.....	Easterly side, on terminus north of Westford Street.
Foundry .....	Northerly side, 177 ft. east of Main Street.
Howard... ..	Westerly side, 400 ft. north of Tanners Street.
Jackson.....	Southerly side, 33½ ft. easterly of Elliot Street.
Jackson.....	Southerly side, 5 ft. easterly of South Street.
Meadowcroft .....	Easterly side, on terminus.
Midland.....	Northerly side, 287 ft. east of Stevens Street.
Moody St. Ex.....	On terminus, westerly side.
Mt. Hope.....	Westerly side, 333 ft. north of Fifth Avenue.
Otis .....	Northerly side, 3 ft. west of Bourne Street.
Pleasant .....	Westerly side, 28 ft. north of Rogers Street.
Roberts .....	Westerly side, on terminus.
Sayles.....	Westerly side, near Princeton Street.
Short.....	Easterly side, 174 ft. south of Chelmsford Street.
Stackpole.....	Northerly side, opp. Fayette Street.
Tolman Ave.....	Southerly side, 680 ft. west of Mammoth Road.
Victoria.....	Northerly side, 6 ft. west of Chelmsford Street.



**LOW SERVICE.—LIST OF HYDRANTS SET DURING 1895.—Continued.**

STREETS.	LOCATION.
Wells .....	At No. 2 Station.
Wells.....	At No. 3 Station.
Whipple .....	Westerly side, 144 ft. south of Watson Street.
Wilder .....	Westerly side, opp. A Street.
Wilder .....	Easterly side, 3 ft. south of Broadway.
Wilder .....	Easterly side, 21 ft. north of Marginal Street.

**HIGH SERVICE.—LIST OF STOP GATES SET DURING THE YEAR 1895.**

STREETS.	LOCATION.
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**HIGH SERVICE.—LIST OF HYDRANTS SET DURING THE YEAR 1895.**

STREETS.	LOCATION.
Berkeley Ave.....	Northerly side, on terminus.
Butman Rd.....	Westerly side, 118 ft. north of Mansur Street.
Butman Rd.....	Westerly side, 444 ft. south of Mansur Street.
Holyrood. ....	Westerly side, on terminus.
Mt. Pleasant.....	Easterly side.

## STOCK ON HAND JAN. 1, 1896.

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**CAST IRON PIPE** (short pieces).—30-inch, 6 ft.; 24-inch, 323 ft.; 20-inch, 260 ft.; 16-inch, 97 ft.; 12-inch, 32 ft.; 10-inch, 45 ft.; 8-inch, 28 ft.; 6-inch, 36 ft.; 4-inch, 204 ft. One 30-inch manhole, 14 6-inch S curves, 1 30-inch clamp sleeve, 1 24-inch clamp sleeve, 2 6-inch Smith gates, 1 2-inch Smith gate, 1 8x6 Smith sleeve, 1 6x2 Smith sleeve. **HYDRANTS**.—Michigan, 6; Eddy, 1; Chapman, 3; Ludlow, 3; Lowry, 1. **GATES**.—10-inch, 1; 8-inch, 7; 6-inch, 4; 4-inch, 2; 54 iron gate boxes, 60 wooden gate box frames and covers, 19 wooden hydrant boxes with frames and covers, 165 feet of 1-inch lead pipe, 353 feet of  $\frac{3}{4}$ -inch lead pipe, 5352 feet of  $\frac{5}{8}$ -inch lead pipe, 20 feet of 2-inch lead pipe, 10 feet of 3-inch lead pipe, 185 feet of 2-inch lead-lined iron pipe, 550 feet of 1-inch lead-lined iron pipe, 573 feet of  $\frac{3}{4}$ -inch lead-lined iron pipe, 12 feet of  $1\frac{1}{4}$ -inch iron pipe, 186 feet of 1-inch iron pipe, 33 feet of  $1\frac{1}{2}$ -inch iron pipe. **Corporation Cocks**, 1-inch, 37;  $\frac{3}{4}$ -inch, 629. **Sidewalk cocks**, 1-inch, 34;  $\frac{3}{4}$ -inch, 748. **Cellar Cocks**, 1-inch, 33;  $\frac{3}{4}$ -inch, 930, 58  $\frac{3}{4}$ -inch tail-pieces for service cocks, 27 1-inch tail-pieces for cellar cocks, 33 1-inch tail-pieces for corporation cocks, 12 iron service boxes. **Crown Meters**, 2-inch, 1;  $1\frac{1}{2}$ -inch, 2; 1-inch, 13;  $\frac{3}{4}$ -inch, 25;  $\frac{5}{8}$ -inch, 28. **Nash Meters**,  $\frac{3}{4}$ -inch, 6;  $\frac{5}{8}$ -inch, 5. **Gem Meters**, 6-inch, 1. **Worthington Meters**, 2-inch, 4;  $1\frac{1}{2}$ -inch, 1. **Disc Meters**,  $\frac{3}{4}$ -inch, 1;  $\frac{5}{8}$ -inch, 1; 1  $\frac{3}{4}$ -inch Niagara Meter, 1 1-inch Metropolitan Meter, 1 1-inch Bee Meter. **Crown meter tops**, 1-inch, 7;  $\frac{3}{4}$ -inch, 10;  $\frac{5}{8}$ -inch, 17. 7 faces for Crown meter clocks. **Crown meter unions**, 1-inch, 24;  $\frac{3}{4}$ -inch, 146;  $\frac{5}{8}$ -inch, 101; 12 2-inch Peet valves; 2 2-inch Chapman valves; 15  $1\frac{1}{2}$ -inch Chapman valves; 4 brass caps for fountain overflows. **Brass elbows**, 1-inch, 72;  $1\frac{1}{2}$ -inch, 83;  $\frac{3}{4}$ -inch, 170;  $1\frac{1}{2}$ -inch, 23;  $\frac{3}{4}\times\frac{1}{2}$ -inch, 27. **Brass couplings**,  $1\frac{1}{2}$ -inch,

1; 1-inch, 51;  $1\frac{3}{4}$ -inch, 20;  $1\frac{1}{2}$ -inch, 11;  $\frac{3}{4}$ -inch, 35;  $\frac{3}{4}\times\frac{1}{2}$ -inch, 88. Brass nipples, 1-inch, 30;  $1\frac{3}{4}$ -inch, 21;  $\frac{3}{4}$ -inch, 24;  $\frac{1}{2}$ -inch, 21. Brass tees,  $1\frac{3}{4}$ -inch, 4;  $\frac{3}{4}$ -inch, 1. Brass plugs,  $\frac{3}{4}$ -inch, 1. Brass fourway,  $\frac{3}{4}$ -inch, 1. Iron tees, lead-lined, 2-inch, 6;  $2\times1\frac{1}{2}$ -inch, 2;  $2\times1\frac{1}{4}$ -inch, 1;  $2\times1$ -inch, 6;  $2\times\frac{3}{4}$ -inch, 6; 1-inch, 12;  $\frac{3}{4}$ -inch, 12. Iron tees,  $2\frac{1}{2}\times1\frac{1}{2}$ -inch, 3; 2-inch, 2;  $2\times1\frac{1}{2}$ -inch, 3;  $2\times1\frac{1}{4}$ -inch, 1;  $2\times1$ -inch, 1;  $1\frac{1}{2}$ -inch, 9;  $1\frac{1}{2}\times1$ -inch, 2;  $1\frac{1}{4}$ -inch, 3;  $1\frac{1}{4}\times\frac{3}{4}$ -inch, 3; 1-inch, 1;  $\frac{3}{4}$ -inch, 3. Iron fourways,  $2\times1\frac{1}{2}$ -inch, 2;  $2\times1$ -inch, 9;  $1\frac{1}{2}\times1$ -inch, 9; 1-inch, 12;  $\frac{3}{4}$ -inch, 8. Iron caps, 1-inch, 2. Iron Y's,  $2\times1$ -inch, 9. Iron Y's, lead-lined,  $2\times1\frac{1}{2}$ -inch, 16. Iron plugs,  $1\frac{1}{4}$ -inch, 2; 1-inch, 3. Iron elbows,  $1\frac{1}{2}$ -inch, 14;  $1\frac{1}{2}\times1$ -inch, 11;  $1\frac{1}{4}$ -inch, 5;  $1\frac{1}{4}\times1$ -inch, 14;  $1\frac{1}{4}\times\frac{3}{4}$ -inch, 2; 1-inch, 47;  $1\times\frac{3}{4}$ -inch, 68;  $1\times\frac{1}{2}$ -inch, 43;  $\frac{3}{4}$ -inch, 73;  $\frac{3}{4}\times\frac{1}{2}$ -inch, 83. Iron elbows, lead-lined,  $2\frac{1}{2}\times2$ -inch, 2; 2-inch, 3;  $1\frac{1}{2}$ -inch, 1; 1-inch, 9;  $\frac{3}{4}$ -inch, 12. Iron couplings, 2-inch, 15;  $1\frac{1}{2}$ -inch, 3;  $1\frac{1}{4}$ -inch, 3; 1-inch, 35;  $\frac{3}{4}$ -inch, 6. Right and left couplings,  $1\frac{1}{2}$ -inch, 5;  $1\frac{1}{4}$ -inch, 3; 1-inch, 8;  $\frac{3}{4}$ -inch, 10;  $\frac{1}{2}$ -inch, 3. Reducing couplings,  $2\times1\frac{1}{2}$ -inch, 4;  $1\frac{1}{2}\times1$ -inch, 6;  $1\frac{1}{4}\times1$ -inch, 20;  $1\frac{1}{4}\times\frac{3}{4}$ -inch, 7;  $1\times\frac{3}{4}$ -inch, 49;  $1\times\frac{1}{2}$ -inch, 22;  $\frac{3}{4}\times\frac{1}{2}$ -inch, 77. Iron unions,  $2\frac{1}{2}$ -inch, 1; 2-inch, 8;  $1\frac{1}{2}$ -inch, 2; 1-inch, 3;  $\frac{3}{4}$ -inch, 4. Iron nipples,  $2\frac{1}{2}$ -inch, 5; 2-inch, 19;  $1\frac{1}{2}$ -inch, 9;  $1\frac{1}{4}$ -inch, 6; 1-inch, 54;  $\frac{3}{4}$ -inch, 11. Iron bushings,  $2\times1\frac{1}{2}$ -inch, 4;  $1\frac{1}{4}\times1$ -inch, 2;  $1\frac{1}{4}\times\frac{3}{4}$ -inch, 1;  $1\frac{1}{4}\times\frac{1}{2}$ -inch, 4;  $1\times\frac{3}{4}$ -inch, 50;  $\frac{3}{4}\times\frac{1}{2}$ -inch, 125; 7 iron plates for gates, 8 nipples and gates for Independent outlet Chapman Hydrants, 21 leather valves for flush hydrants, 34 caps for gate spindles, 15 caps for flush hydrant valves, 6 stuffing boxes, 11 complete post hydrant spindles, 1 bushing for post hydrant; 3 caps for post hydrant, 10 caps for hydrant nozzles, 190 assorted rubber packings for gates and hydrants, 2 rolls packing rubber, 14 hydrant nipples, 12 hose nipples, 69 assorted gate spindles, 38 screws for hydrant spindles; 2 hydrant reducers for hose, 4 pieces steel for hand ratchets, 3 galvanized iron water pails,  $\frac{1}{2}$  barrel oatmeal,  $\frac{1}{3}$  barrel salt, 4 cans paint, 53 caulking hammer handles, 24 striking hammer handles, 3 axe handles, 20 monkey wrenches, 12 lead paper weights, 4 boxes tacks,  $\frac{1}{2}$  box toilet paper, 35 sheets sandpaper, 1 box dualin, 47 lead goosenecks, 40 barrels cement, 15 pieces drain pipe, 1 load of brick, 25 cords wood, 308 lbs. wiping solder, 300 lbs. fine solder, 1 lb. washers, 2 lbs. sealing wax, 10 lbs. lead seals, 5 lamp wicks, 20 lbs. brass service checks, 300 lbs. steel, 9 compression cocks, 2  $4\frac{1}{2}$ -inch steam gauges, 4  $\frac{3}{4}$ -inch dies, 2 2-inch dies, 1 ton lead dross, 13120 lbs. pig lead, 1 box of Columbia Metal Polish.

#### Property and Tools at Shop, Hampshire Street.

1  $8\times10$  plain slide valve engine, 1 10-ft. engine lathe, 1 7-ft. engine lathe, 1 6-ft. brass finishing lathe, 1 5-ft. speed lathe, 1 shaper, 1 upright drill, 1 emery wheel, 1 grindstone, 2 soldering furnaces, 1 large end chuck, 2 independent chucks, 3 drill chucks, 9 twist drills, 12 flat drills, 12 flat chucking drills, 38 turning tools, 10 steel arbors, 10 lathe dogs, 19 reamers, 3 reamers for Desper meters, 17 taps, 3 tap wrenches, 1 A. P. Smith tapping machine, 4 tapping machines with rubbers, 6 taps and drills, 1 hand vise, 3 bench vises, 2 pipe vises, 1 30-inch, 1 24-inch, 1 20-inch, 1 16-inch, 1 12-inch, 1 10-inch, 1 8-inch, and 2 6-inch clips and clamps, 1 blasting battery

and wires, 3 marine pumps, 11 lengths suction hose, 5 lengths 2½-inch hose, 100 ft. block tin tubing, 50 ft. block tin rod, 4 brass hand pumps, 3 dutchmen, 2 nozzles, 1 pair chain tongs, 8 Stillson wrenches, 7 monkey wrenches, 9 die stocks, 10 dies, 7 pipe cutters, 7 pipe tongs, 2 ratchets, 1 gate ratchet, 6 cold chisels, 2 bit stocks, 1 set of bits, 1 set of wood chisels, 3 hand saws, 3 platform scales, 3 pairs pliers, 1 pair round-nose pliers, 2 soldering irons, 6 files, 1 belt punch, 1 set steel figures, 1 set brass stencils, 2 naphtha furnaces, 1 set plumber's tools, 1 naphtha can, 1 large oil can, 4 small oil cans, 2 hack saws, 1 pair scissors, 1 nail puller, 1 wire cutter, 1 pair snips, 8 lbs. iron wire, 2 putty knives, 1 saw set, 6 S wrenches, 1 fore-plane, 1 forge, 1 anvil, 1 set blacksmith tools, 5 screwdrivers, 1 hand boring bar, 1 draw shave, 1 marlin spike, 1 pail, 1 naphtha lamp, 2 small meter wrenches, 1 L. W. W. seal, 1 hammer, set of tools for sealing fire services, 2 tool-bags, 30 ft. 4-inch pipe, 8 4-inch elbows, 10 flanges and bolts for testing meters, 1 step-ladder, 1 clock, 2 gate plans, 1 map of water mains, 3 desks, 2 chairs, 1 floor brush, 2 dust-pans, 1 water cooler, 1 cuspidor, 1 mirror, 1 copper boiler, 1 gas radiator, 1 can of glue, 12 pieces steel for taps, 1 can for old waste, 1 head for Deane pump, 38½ lbs. brass castings for Deane pump, 150 lbs. old brass, 13 castings for fountains, 2 keys Morris engine.

#### **Property at Superintendent's Office.**

Two desks, 3 chairs, 1 case drawers and bookcase, 1 hat rack, 1 letter file, 1 letter press and stand, 2 pictures, 2 diagrams, 1 gate plan, 1 duster, 1 Howard electric watch clock, 1 cuspidor, 15 framed notices.

#### **Property and Tools at Pumping Station No. 1.**

11 wrenches High Duty Worthington, 10 wrenches Low Duty Worthington, 11 wrenches Morris engine, 7 sets brasses Morris engine, 1 set rubber valves Morris engine air pump, 6 9-inch rubber valves, 10 7-inch rubber valves, 9 4-inch rubber valves, 1 oil cupboard, 1 oil filter, 5 gals. cylinder oil, 8 gals. engine oil, 2 sets of oil cans, 1 work-bench, 1 bench vise, 11 drills, 5 cold chisels, 10 taps, 3 bit stocks, 4 bits, 1 2-inch augur, 1 1-inch augur, 5 monkey wrenches, 9 pair pipe tongs, 3 sledges, 1 copper hammer, 6 socket wrenches, 1 2-foot steel square, 1 ladle, 1 hack saw, 1 keyhole saw, 4 jack screws, 5 crow bars, 1 pair gas pliers, 3 hammers, 1 tool cupboard, 2 sets differential blocks, 4 pairs rope falls, 1 set fire irons, 2 coal shovels, 2 long handle shovels, 2 platform scales, 1 hay scale, 3 iron wheel barrows, 1 truck, 2 clocks, 1 barometer, 2 thermometers, 2 indicators, 3 steam gauges, 9 guage glasses, 100 feet ¾-inch rubber hose, 1 gas lamp and tubing, 1 24-inch elbow, 12 grate sections with bars, 2 side bars, 1 10-inch valve, 1 saw horse, 1 bookcase, 5 chairs, 1 table, 1 desk, 1 bedstead and bed, 2 mops, 5 cuspidors, 2 floor brushes, 2 dust brushes, 1 dust-pan, 2 tube scrapers, 1 tube hose and blower, 1 2-inch Jenkins valve, 2 check valves H. D. W., 1 set drawings H. D. W., 2 ratchet drills, 1 ice tongs, 2 iron brushes, 6 ladders, 3 pair steps, 1 set gears Morris engine valve, 24 eyebolts, 2 lawn mowers, 3 hoes, 1 rake, 1 water pail, 3 iron pails, 1 waste

can, 100 lbs. waste, 50 cakes soap, 20 lbs. metallic packing, 18 lbs. ring packing, 21 lbs. Eureka packing, 10 lbs. square tuck packing, 25 lbs. Italian flax, 2 Stillson wrenches, 10 large wrenches, 1 pair calipers, 1 level, 2 whitewash brushes.

#### **Property and Tools at Pumping Station No. 2.**

1 work bench and vise, 1 bit stock, 1 set of bits, 1 thermometer, 1 clock, 7 cold chisels, 4 monkey wrenches, 10 socket wrenches, 14 wrenches, 2 pinch bars, 2 gate wrenches, 3 steel drills, 1 1½-inch pipe tongs, 1 1-inch pipe tongs, 6 caulking hammers, 1 sledge hammer, 1 coal hammer, 2 long steel chisels, 4 taps, 1 axe, 2 ice chisels, 4 grapple rakes, 1 iron rake, 5 hand hole gaskets, 2 slicing bars, 1 boiler hoe, 2 long handle shovels, 2 iron wheel barrows, 6 lamps, 1 platform scales, 200 feet cotton hose, 2 brooms, 2 dust brushes, 1 map of Lowell, 3 Stillson wrenches, 1 gal. measure, 2 5-gal. cans, 100 lbs. waste, 35 gals. spindle oil, 1 tunnel, 10 lbs. hemp packing, 2 oil cans, 1 glass pitcher, 1 doz. glasses, 2 boxes metallic gum core packing, 8 valves and spindles for Deane pump, 40 valve plates, 40 springs, 1 desk, 4 chairs, 1 grindstone, 2 rings for water piston, 48 sheets emery cloth, 2 files, 1 copper hammer, 2 ladders, 1 step ladder, 2 iron pails, 1 map, 1 bbl. of soda ash, 25 feet of 1-inch hose, 2 picks, 2 shovels, 2 pair rubber boots, 3 yards rainbow packing, 6 guage glasses.

#### **Property and Tools at Tool House.**

161 shovels, 101 picks, 65 pick handles, 37 mauls, 6 driving mauls, 15 striking hammers, 1 sledge hammer, 3 lead pots, 5 ladles, 8 hoes, 20 gate wrenches, 31 sidewalk wrenches, 10 flush hydrant wrenches, 11 post hydrant wrenches, 2 fork wrenches, 3 spoon shovels, 1 long handle shovel, 5 pails, 5 caulking hammers, 2 oil cans, 7 crowbars, 8 tag ropes, 4 set derrick falls, 5 chains, 30 lanterns, 7 square pointed shovels, 2 cutters, 21 pair of rubber boots, 1 portable forge, 1 anvil, 5 stone wedges, 2 axes, 3 saws, 3 bucksaws, 1 level, 2 monkey wrenches, 2 lines, 3 tool boxes, 2 sawhorses, 3 wheelbarrows, 3 sets of paving tools, 4 derricks, 300 lbs. steel drills, 2 sets of caulking tools.

#### **Property at Stable.**

8 horses, 8 single harnesses, 1 double harness, 8 street blankets, 8 stable blankets, 2 democrat wagons, 1 Goddard buggy, 7 sleighs, 4 wagons, 1 single truck, 1 double truck, 2 brooms, 6 brushes, 6 curry combs, 7 pitchforks, 50 feet 1-inch rubber hose, 6 rubber horse covers, 1 string of bells, 1 chamois skin, ½ box harness soap, 6 sponges, 1 wagon jack, 1 hay cutter, 2 feed boxes, 1 sprinkling can, 11 whips, 2 tons hay, 300 bushels of oats, 6 bags of corn, 6 bags of shorts, 2 bales of straw, 3 lap robes, 1 wolf skin robe, 10 lbs. grease.

**Property at Reservoir.**

Two lawn mowers, 1 boat, 1 iron rake, 1 wooden rake, 2 shovels, 1 snow shovel, 1 hoe, 1 crowbar, 1 axe, 1 ice pick, 1 saw, 1 square, 1 monkey wrench, 1 scythe and snath, 1 lantern, 1 broom.

**Property at Filter Gallery.**

7 hoes, 2 shovels, 1 pick, 1 ice chisel, 2 rakes, 2 gate wrenches, 2 boats, 2 sets of falls, 2 tag ropes, 1 pail, 1 ice rake and hook, 1 oil can, 1 hose.

**Movable Fixtures and Property at Office, City Hall.**

Two roll-top desks, 2 standing desks, 1 double flat desk, 1 3-place inspector's desk, 2 single inspector's desks, 2 heavy oak tables, 1 typewriter desk, 1 Remington typewriter, 2 small tables, 1 vault table, 2 swivel upholstered chairs, 6 upholstered chairs, 12 cane-seated armchairs, 3 swivel cane-seated chairs, 2 high chairs, 3 stools, 1 step-chair, 1 settee, 1 bookcase, 1 water-tank, 2 water-pressure gauges, 3 thermometers, 1 clock, 2 table gas-lamps, 2 Crown meters, 33 framed pictures—plans, etc.; 2 floor rugs, 2 rubber mats, 1 set street tools, 2 earthen spittoons, 6 brass spittoons, 5 waste paper baskets, 1 shovel (historic), 2 mirrors, 1 letter copying-press, 1 umbrella rack, 20 ink stands, 2 pen racks, 1 gas stove, 3 book racks, set tools (hammer, wrench, 2 screwdrivers, wire cutter), 3 tumblers, boot-blackening outfit, 1 hair brush, 1 clothes brush, 1 dozen towels, 1 match chest, 1 fire-insurance map of Lowell, 5 tin yearly boxes, 1 copy stand, 1 set Massachusetts statutes, 1 large dictionary, 1 large photo. album, 1 revolving book case.

# REPORT OF THE CITY ENGINEER.

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OFFICE OF THE CITY ENGINEER.

LOWELL, MASS., January 1, 1896.

TO THE LOWELL WATER BOARD,

*Gentlemen,*—The Twenty-third annual report of the work of the pumping engines at the pumping stations of the Lowell Water Works is as follows:

The total pumpage for the year was 2,527,811,749 gallons.

This quantity is 131,956,817 gallons greater than the pumpage of 1894.

The quantity in U. S. gallons pumped at each station during the year 1895, is as follows:

## FROM MERRIMACK RIVER.

At Station No. 1 (West Sixth Street engine house).

By Morris pumping engine . . . . . 537,624,640

By Worthington Duplex pumping engine . 185,483,230

By Worthington High Duty pumping engine, 93,821,250

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816,929,120

## FROM DRIVEN WELLS.

At Station No. 2 (Cook plant).

By Deane pumping engines . . . . . 896,805,876

At Station No. 3 (Hydraulic Construction Company's plant).

By Worthington pumping engines . . . 814,076,753

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1,710,882,629

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2,527,811,749

The quantity pumped by the Worthington high service engine from the low service mains was 31,219,104 gallons.

The average cost of pumping into the low service reservoir with the engines at the pumping station on West Sixth street has been nine dollars and four cents (\$9.04) per million gallons.

The cost of pumping from the low service mains into the high service reservoir has been eight dollars and seventy-three cents (\$8.73) per million gallons.

The calculations for the following tables have been made from the records kept by Mr. Daniel Hart, Jr., Chief Engineer at the West Sixth street pumping station, and by Mr. Frank Lapoint, Gate Keeper at the reservoir.



**TABLE SHOWING WORK DONE WITH MORRIS ENGINE (BEAM AND FLY WHEEL) FOR EACH  
MONTH DURING THE YEAR 1895.**

MONTHS.	No of days pump- ing.	Average No. of hours pumping per day.	No. of hours pumping per month.	No. of strokes made per month.	Average No. of strokes made per minute.	Average head, in- cluding friction, in feet.	Quantity pumped per month in U. S. gal- lons.	Average quantity pumped per day in U. S. gallons.	No. gals. of water pumped into res- ervoir per lb. total coal con- sumed.	Duty in lbs. 1 ft. high with 100 for ashes or clinkers.	Duty on total coal consumed, no deduction for ashes or clinkers.
January.....	11	28-04	253-45	183,123	12.03	100.59	58,599,360	5,327,215	627	84,802,294	83,895,135
February.....	6	18-08	108-45	79,509	12.20	101.20	25,471,680	4,245,280	628	88,755,510	84,378,462
March.....	25	17-15	431-15	301,368	11.65	100.56	96,437,760	3,857,510	657	92,509,979	87,000,367
April.....	9	9-57	89-30	62,042	11.67	101.55	20,045,440	2,227,271	626	97,734,227	84,301,654
May.....	21	9-31	200-00	134,007	11.22	102.72	48,074,240	2,051,154	629	103,329,738	85,236,353
June.....	25	11-50	295-45	202,502	11.41	102.45	64,800,640	2,592,026	650	101,915,469	88,010,740
July.....	28	7-44	216-30	143,156	11.02	103.02	45,809,920	1,636,069	641	107,191,852	87,092,060
August.....	25	10-12	255-05	174,580	11.41	103.09	55,865,600	2,234,624	653	101,924,977	88,707,755
September.....	29	12-11	353-30	245,931	11.00	104.07	78,697,920	2,713,721	652	99,311,140	89,441,796
October.....	20	9-27	189-00	132,256	11.06	104.89	42,321,920	2,116,090	649	104,355,721	89,157,755
November.....	.....	.....	.....	.....	.....	.....	.....	.....	...	.....	.....
December.....	4	7-28	29-45	20,313	11.38	104.48	6,500,160	1,025,040	644	88,246,640	88,246,640
<b>Totals and Averages.</b>	<b>203</b>	<b>11-50</b>	<b>2,422 50</b>	<b>1,080,077</b>	<b>11.56</b>	<b>102.83</b>	<b>537,624,640</b>	<b>2,648,397</b>	<b>645</b>	<b>97,549,778</b>	<b>87,468,440</b>

**TABLE SHOWING WORK DONE WITH WORTHINGTON DUPLEX ENGINE FOR EACH MONTH  
DURING THE YEAR 1895.**

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**TABLE SHOWING WORK DONE WITH WORTHINGTON HIGH DUTY ENGINE FOR EACH MONTH  
DURING THE YEAR 1893.**

**TABLE SHOWING AMOUNT OF COAL USED FOR MORRIS  
ENGINE AT PUMPING STATION DURING  
THE YEAR 1895.**

MONTHS.	COAL CONSUMED.			
	For starting fires, in lbs.	When pump- ing in lbs.	For banking fires, in lbs.	Total per month, in lbs.
January.....	1,000	92,482	.....	93,482
February .....	1,800	38,555	200	40,555
March .....	6,200	139,492	1,000	146,692
April .....	4,400	27,614	.....	32,014
May.....	8,400	56,531	3,600	68,531
June .....	9,200	86,082	4,400	99,682
July .....	8,400	58,062	5,000	71,462
August .....	7,100	74,498	4,000	85,598
September .....	7,200	108,751	4,800	120,751
October. ....	5,700	55,731	3,800	65,231
November.....	.....	.....	.....	.....
December.....	.....	10,097	.....	10,097
Totals .....	59,400	747,895	26,800	834,095

**TABLE SHOWING AMOUNT OF COAL USED FOR WORTH-  
INGTON DUPLEX ENGINE AT PUMPING STATION  
DURING THE YEAR 1895.**

MONTHS.	COAL CONSUMED.			
	For starting fires, in lbs.	When pump- ing, in lbs.	For banking fires, in lbs.	Total per month, in lbs.
January .....	2,800	161,406	200	164,406
February .....	1,000	246,235	.....	247,235
March. ....	.....	64,579	.....	64,579
April .....	. . .	.....	. . . .	.....
May .....	.....	.....	.....	.....
June .....	.....	.....	.....	.....
July .....	. . .	.....	.....	.....
August .....	2,800	18,944	800	22,544
September .....	.....	.....	.....	.....
October .....	.....	.....	.....	.....
November.....	. . . .	.....	.....	.....
December .....	.....	.....	.....	.....
Totals .....	6,600	491,164	1,000	498,764

**TABLE SHOWING AMOUNT OF COAL USED FOR WORTH-  
INGTON HIGH DUTY ENGINE AT PUMPING  
STATION DURING THE YEAR 1895.**

MONTHS.	COAL CONSUMED.			
	For starting fires, in lbs.	When pump- ing, in lbs.	For banking fires, in lbs.	Total per month, in lbs.
January .....	3,600	48,341	.....	51,941
February .....	1,000	86,066	.....	87,066
March .....	.....	.....	.....	.....
April .....	.....	.....	.....	.....
May.....	.....	.....	.....	.....
June .....	.....	.....	.....	.....
July.....	.....	.....	.....	.....
August .....	.....	.....	.....	.....
September .....	.....	3,790	.....	3,790
October. ....	.....	.....	.....	.....
November.....	.....	.....	.....	.....
December .....	1,000	5,202	.....	6,202
Totals .....	5,600	143,399	.....	148,999

TABLE SHOWING WORK DONE WITH WORTHINGTON HIGH SERVICE ENGINE FOR EACH MONTH DURING THE YEAR 1895.

MONTHS.	No. of days pump- ing.	Average No. of hours pumping per day.	No. of hours pumping per month.	No. of strokes made per month.	Average No. of strokes made per minute.	Average head, including friction, in feet.	Quantity pumped per month in U. S. gallons.	Average quantity pumped per day in U. S. gallons.	No. gals. of water pumped into reser- voir per lb. total coal con- sumed.	Coal in lbs., used when pumping.
January .....	9	10-37	95-30	182,389	31.83	70.35	2,553,446	283,716	300	8,510
February .....	8	12-34	100-30	185,590	30.78	70.90	2,598,260	324,783	300	8,659
March .....	9	11-25	102-45	203,567	33.02	70.74	2,849,938	316,660	300	9,497
April .....	7	7-56	55-30	135,439	40.67	71.60	1,896,146	270,878	300	6,319
May .....	8	9-02	72-15	168,421	38.85	70.60	2,357,894	294,737	300	7,859
June .....	10	10-58	109-40	262,405	39.88	71.41	3,673,670	367,367	300	12,234
July .....	10	8-36	86-00	212,239	41.13	71.53	2,971,346	297,135	300	9,904
August .....	10	8-53	88-45	214,855	40.35	70.60	3,007,970	300,797	300	10,026
September .....	8	10-14	81-55	201,404	40.98	69.17	2,819,656	352,457	300	9,399
October .....	8	8-06	64-45	167,228	43.04	69.31	2,341,192	292,649	300	7,803
November .....	8	7-52	63-00	151,391	40.05	70.16	2,119,474	264,934	300	7,065
December .....	7	8-56	62-30	145,008	38.67	72.08	2,030,112	290,016	300	6,768
Totals and Averages ...	102	9-38	983-05	2,229,936	37.81	70.69	31,219,104	306,070	300	104,043

### PUMPING STATION—MORRIS ENGINE

#### RUNNING EXPENSES FOR THE YEAR 1895.

Pay of engineers and firemen.....	\$2,589 46
190 $\frac{1}{2}$ <del>274</del> tons of coal (Cumberland, 1894), at \$3.884..	740 43
92 $\frac{1}{2}$ <del>320</del> tons of coal (Cumberland, 1895), at \$3.786...	348 56
134 $\frac{1}{2}$ <del>320</del> tons of coal (Cumberland, 1895), at \$3.705..	497 75
4 $\frac{1}{2}$ <del>100</del> cords of wood, at \$4.00.....	18 48
Electric light.....	62 70
Gas for lighting works.....	63 56
87 $\frac{1}{2}$ gallons of cylinder oil, at \$0.74 <del>100</del> .....	65 56
66 gallons of engine oil, at \$0.35.....	23 10
25 pounds of tallow, at \$0.05.....	1 25
27 $\frac{1}{2}$ pounds of packing.....	13 13
197 pounds of cotton waste, at \$0.08.....	15 76
Repairs on engine.....	55 44
Repairs on boilers.....	83 62
Tools and stock.....	21 58
Sundries.....	6 08

---

Total ..... \$4,606 46

Cost of pumping water into reservoir per million gallons.....	\$8 57
Cost of pumping water one foot high per million gallons.....	.05 <del>100</del> <sup>26</sup>



**PUMPING STATION — WORTHINGTON DUPLEX ENGINE.**

**RUNNING EXPENSES FOR THE YEAR 1895.**

Pay of engineers and firemen.....	\$902 39
238 <sup>220</sup> / <sub>1000</sub> tons of coal (Cumberland, 1894), at \$3.884...	924 82
11 <sup>44</sup> / <sub>1000</sub> tons of coal (Cumberland, 1895), at \$3.705...	41 76
1 <sup>61</sup> / <sub>100</sub> cords of wood, at \$4.00.....	6 44
Electric light .....	21 85
Gas for lighting works.....	22 15
30 gallons of cylinder oil, at \$0.74 <sup>93</sup> / <sub>100</sub> .....	22 48
23 gallons of engine oil, at \$0.35.....	8 05
8½ pounds of packing, at \$0.48.....	4 08
69 pounds of cotton waste, at \$0.08.....	5 52
Repairs on boilers.....	29 14
Tools and stock.....	4 31
Sundries.....	2 12
<hr/>	
Total .....	\$1,995 11

Cost of pumping water into reservoir per million gallons.....	\$10 76
Cost of pumping water one foot high per million gallons.....	.06 <sup>73</sup> / <sub>100</sub>

PUMPING STATION—WORTHINGTON HIGH DUTY ENGINE

RUNNING EXPENSES FOR THE YEAR 1895.

Pay of engineers and firemen.....	\$431 57
69 $\frac{1}{2}$ <del>888</del> tons of coal (Cumberland, 1894), at \$3.884....	269 95
3 <del>202</del> <del>888</del> tons of coal (Cumberland, 1895), at \$3.786.....	11 74
1 $\frac{1}{2}$ <del>888</del> tons of coal (Cumberland, 1895), at \$3.705.....	7 02
1 $\frac{7}{10}$ cord of wood, at \$4.00.....	3 08
Electric light.....	10 45
Gas for lighting works .....	10 59
15 gallons of cylinder oil, at \$0.74 <del>100</del> <sup>93</sup> .....	11 24
10 $\frac{1}{2}$ gallons of engine oil, at \$0.35.....	3 67
5 pounds of packing.....	3 51
32 pounds of cotton waste, at \$0.08.....	2 56
Repairs on boilers.....	13 94
Tools and stock.....	2 07
Sundries.....	1 01
Total .....	\$782 40

Cost of pumping water into reservoir per million gallons.....	\$8 34
Cost of pumping water one foot high per million gallons.....	.05 <del>17</del> <del>100</del>

**RESERVOIR, BEACON STREET, 1895.**

MONTHS.	Depth in feet.	Quantity in U. S. gallons.	Temperature in degrees.	
			Of Water.	Of Air.
January. ....	18.95	28,748,045	33.77	25.15
February. ....	18.93	28,711,878	33.75	22.51
March. ....	19.85	30,266,835	35.06	33.08
April. ....	19.09	28,977,718	43.91	46.22
May. ....	17.55	26,428,369	55.04	61.93
June. ....	18.65	28,245,459	67.50	70.51
July. ....	18.35	28,579,844	66.78	70.26
August. ....	18.39	27,812,391	67.70	71.44
September. ....	18.99	28,812,033	67.14	65.28
October. ....	19.10	29,001,413	54.55	46.88
November. ....	19.72	30,046,244	47.68	42.25
December. ....	18.73	28,388,271	40.35	32.69

**TABLE SHOWING THE AVERAGE MONTHLY AND DAILY  
CONSUMPTION OF WATER FOR THE YEAR 1895.**

<b>MONTHS.</b>	<b>Gallons per month.</b>	<b>Gallons per day.</b>
January.....	225,695,012	7,280,484
February.....	232,912,386	8,318,300
March .....	200,558,515	6,469,630
April .....	181,047,386	6,034,913
May .....	200,018,561	6,452,212
June .....	211,001,254	7,033,375
July.....	218,010,183	7,032,587
August.....	227,646,812	7,343,446
September.....	214,590,899	7,153,030
October .....	206,902,274	6,674,267
November.....	187,472,284	6,249,076
December .....	220,708,020	7,119,614
<b>Totals and Averages....</b>	<b>2,526,563,586</b>	<b>6,922,092</b>

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Totals and Averages....	2,526,563,586	6,922,092

## SUMMARY OF STATISTICS.

REPORT OF 1895.

*In accordance with the recommendations of the New England  
Water Works Association.*

LOWELL WATER WORKS, MIDDLESEX COUNTY, MASS.

Population by census of 1895 . . . . 84,359.

Date of Construction, 1870 to 1873.

Date of construction, High Service . . . . 1881.

Date of construction, Driven Wells, 1893 to 1896.

Source of supply . . . . Merrimack River, through filter gallery,  
filter bed, and direct, also two hundred ten (210) driven  
wells in the valley of River Meadow Brook.

Mode of supply . . . . Pumping to reservoir, and pumping direct.

## PUMPING.

## 1. Builders of Pumping machinery.

One engine capacity, 5,000,000 gals. in 24 hours . . . . Henry  
G. Morris.

One engine capacity, 5,000,000 gals. in 24 hours . . . . Henry  
R. Worthington.

One engine capacity, 10,000,000 gals. in 24 hours . . . . Henry  
R. Worthington.

One engine capacity, 500,000 gals. in 24 hours . . . . Henry  
R. Worthington.

One engine capacity, 3,000,000 gals. in 24 hours . . . . The  
Deane Steam Pump Co.

One engine capacity, 3,000,000 gals. in 24 hours . . . . The  
Deane Steam Pump Co.

One engine capacity, 3,000,000 gals. in 24 hours . . . . Henry  
R. Worthington.

One engine capacity, 3,000,000 gals. in 24 hours . . . . Henry  
R. Worthington.

## 2. Description of coal used:

(b) Kind... bituminous.

(c) Size ...broken.

(d) Brand....Cumberland (New River, George's Creek, Pocahontas).

(e) Price per gross ton delivered....\$4,296.

(g) Wood, price per cord... \$4.00.

3. Coal consumed for the year in pounds....1,481,858.

4. Wood consumed for the year in pounds.

$$\frac{\text{---}}{3} = \text{coal in lbs.} = 4,200.$$

5. Total fuel consumed for the year, (3) + (4) = 1,486,058 pounds.

6. Total pumpage for the year in gallons....816,929,120.

7. Average static head against which pumps work....155.38 feet.

8. Average dynamic head against which pumps work.161.28 "

9. Number of gallons pumped per pound of coal....551.

10. Duty in foot pounds per 100 pounds of coal, using the following formula, making no deduction for starting or banking fires, or heating building:

$$\text{Duty} = \frac{\text{Gallons pumped (6)} \times 8.34 \text{ (lbs.)} \times 100 \times \text{dynamic head (8)}}{\text{Total fuel consumed (5)}} = 73,942,661.$$

**COST OF PUMPING FIGURED ON PUMPING STATION EXPENSES OF  
\$7,383.97**

11. Per million gallons raised against average dynamic head (8) into reservoir....\$9.04.

12. Per million gallons raised one foot high (dynamic) ...  
.05  $\frac{81}{100}$ .

2 to 12 does not include Driven Wells.

Pumpage from Driven Wells, 1,710,882,629 gallons.



## MORRIS PUMPING ENGINE.

Previous to the year 1892 the Morris pumping engine had been in almost constant use for a period of twenty years.

In the first annual report of the Water Board, dated January 1, 1874, is the following statement in regard to the Morris pumping engine: "During the last week in July the engine was tested by a Board of experts, consisting of J. C. Hoadley, J. B. Francis, and William E. Worthen, to ascertain the capacity and duty of the engine. The contractor, Henry G. Morris of Philadelphia, had guaranteed to the city that the engine should pump into the reservoir 5,000,000 U. S. gallons in twenty-four hours, the lift to be about one hundred fifty-seven (157) feet; and also give a duty of 75,000,000 foot pounds. The engine pumped into the reservoir 5,594,040 gallons in twenty-four hours and gave a duty of 93,002,272 foot pounds, without any deduction for ashes, which is greater than the guaranteed amount by 18,002,272 foot pounds, and by the terms of the contract the contractor has received \$3,600.45 in addition to the contract price of the engine."

In 1892, in view of the fact that the Morris engine had been in constant use for so long a time, and that the duty of the engine had been decreasing each year for several years, the Water Board decided to have a test made in order to ascertain its true condition and determine what repairs were necessary. The services of Mr. George H. Barrus, Mechanical

Engineer of Boston, were secured, and on January 28, 1892, a test was conducted by him, in which the engine developed a duty of but 77,418,178 foot pounds, based on 1,000,000 British units of heat.

In his report on the test, Mr. Barrus says, "The duty realized on the test of the Morris engine, which was, in round numbers, 77,000,000 foot pounds, shows rather poor economy, and, as I understand, the result is much below what has in times past been obtained from the engine. An analysis of the diagrams shows that the cause of the deficiency is a wasteful use of steam, and the leakage test shows that the loss is due largely to blowing of steam past the low-pressure piston. The piston should be provided with packing rings, which are now absent. At the same time, the high-pressure piston should be overhauled, and all the valves ground in, so as to put the engine in a tight condition. One of the steam chests, which I understand is badly corroded, needs renewal. Incidentally, the whole engine should be put in good repair, as soon as it can be spared and laid off for the purpose."

After a thorough examination of the pump by Mr. E. K. Hill, President of the Wheelock Engine Company of Worcester, Mass., a contract was made with that company August 27, 1892, in which they agreed to remodel the engine by furnishing and putting in good running order a complete steam end, as follows:

To "furnish, deliver and erect in running order, a high pressure cylinder, a low pressure cylinder,

new piston rods and packing, piston rods, a receiver, receiver piping, eccentric, eccentric rods and rockers, an entire new valve gear, jacket supply and drip pipe system complete, new bucket and guard complete, one steam supply pipe as far as boiler room wall."

The contract contained a guarantee of a performance of plunger work of not less than 116,000,000 foot pounds with a consumption of 1,000,000 British units of heat, and that the engine should use no more than fourteen pounds of dry steam per indicated horse power per hour. In case the engine failed to develop the above guaranteed duty, it was agreed that there should be deducted from the contract price \$200 for each million foot pounds or fraction thereof below the guaranteed duty.

Under this contract the Wheelock Engine Company proceeded to remodel the engine. This work required more time than was anticipated by the Company, as many unforeseen difficulties were encountered in the reconstruction which had to be overcome, and not until December 1, 1894, did the Company consider the mechanism sufficiently perfected to warrant a duty trial as provided for in the contract. On that date a trial of the engine was conducted by Messrs. Dean & Main, Mechanical and Mill Engineers of Boston, whose services had been secured by the Water Board for that purpose. At this trial the engine failed to reach the required duty by over twenty per cent.; it also used about thirty-two per cent. more dry steam than the amount guaranteed in the contract.

Not being satisfied with the results of this trial, the contractors resumed work on the engine, and on September 24, 1895, a second trial was made at their expense. At this trial, which was conducted by the same experts as before, the results were much better, although still below the guarantee of the contract. A duty of 108,056,120 foot pounds was obtained, which is but 68.5-100 per cent. below the guarantee, and the engine consumed 16.14-100 pounds dry steam per horse power per hour, or 2.14-100 pounds more than required by the contract.

Although these results were not as satisfactory as the Board hoped and the Wheelock Company expected to obtain, yet it was thought best to accept the work of the company and effect a settlement with them on the basis of this trial, which was accordingly done.

Messrs. Dean & Main's reports of the first and second duty trial are appended to this report.

#### THE FIRST TUBE WELL PLANT.

The Cook Wells have yielded a large amount of water during the past year, 896,805,876 gallons having been pumped. As soon as pumping was begun at the second well plant, it became evident that the old second hand boilers used here would no longer furnish enough steam to run the pumps against the increased pressure in the force main. Accordingly, on May 20, the work of taking out the old boilers was begun and the steam was furnished by the boiler

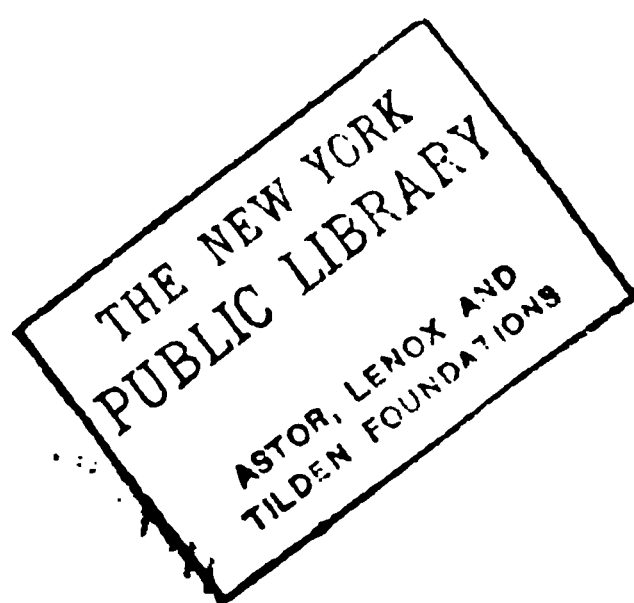
purchased last year; this could supply steam for one pump only, and it was June 20, before there was steam enough to run both pumps at this plant. On September 15, the seven Andrews wells, which were driven and tested in 1892, were connected with the pumps by nine hundred fifty-three (953) feet of ten (10) inch pipe. Since then eleven more wells have been driven along the pipe and connected with it; this work was done in a very efficient manner by the regular water works employes under Superintendent Thomas. Pumping at this plant is still rendered difficult by the amount of air in the water. This trouble will probably remain until the suction mains are all lowered and placed upon a firm foundation.

The State Board of Health has made an analysis of the water from this plant every month, and a copy of the record received from them may be found on Page 110.

#### SECOND TUBE WELL PLANT.

After a great many tests had been made, near the end of the season of 1894 the Hydraulic Construction Company of New York decided on a location for the driven well plant. The place selected was the land lying south of the old Middlesex canal in the town of Chelmsford, and about 2,000 feet east of Chelmsford street, recently purchased by the city. The first work done was the construction of what is now known as Section A. January 3, 1895, this section contained forty-two two (2) inch wells, forty-

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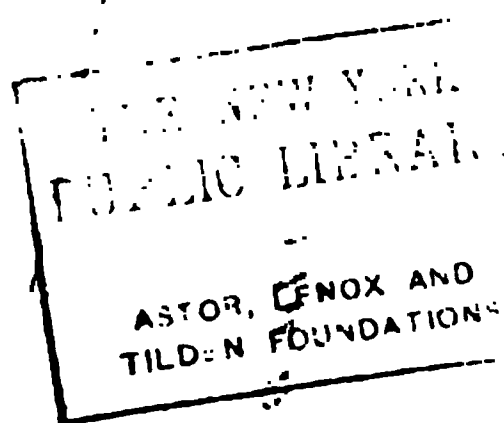
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five (45) feet deep, placed on each side of a twelve (12) inch suction main, twenty-five (25) feet apart, and six (6) feet from the suction main; all the connections were at an angle of forty-five degrees with the main. A test of these wells was begun January 10, ending January 27, actual time of test sixteen days, eleven hours, twenty-three minutes, quantity of water pumped 29,972,597 gallons by meter measurement; during the test the ground water was lowered about ten and one-half (10 1-2) feet. All the temporary tests at this plant were made with a fifty-horse-power engine and an eight-inch centrifugal pump.

Another section (now known as Section B) consisting of seventeen wells was then built, and tested by pumping six days, fifteen hours, thirty-four minutes, the quantity pumped being 5,283,599 gallons. During these tests the suction main was near the surface of the ground, but was afterwards lowered about five feet.

On account of the large amount of water in the ground (it reaching nearly to the surface) it appeared to be a very difficult piece of work to lower the main, excavate for the pit, and build the foundation for the permanent pumps; but by making use of the wells already driven to lower the ground water, this difficulty was, in a large measure, overcome.

A large cast iron receiver was first set in place, then Section A was pumped while Section B was being lowered, the pit excavated, the permanent pumps set in place, and twenty-three more new wells added.



making forty wells in Section B. The permanent pumps were now started and the wells of Section B pumped, while the suction main of Section A was in its turn lowered; while this was being done 2,300,000 gallons of water were daily pumped into the city mains. On June 6, the construction of Section C was begun. This, the third section, was laid out at right angles to the other two sections and was finished October 7, although a portion of this line was in use long before the whole was completed. In building this section a very deep deposit of soil was found, extending about three hundred (300) feet in length and varying from six (6) to thirty-five (35) feet in depth. No wells were driven in this place and the suction main was supported by piles. Every twelve (12) foot length of pipe was supported by four piles driven through the soil into the sand or gravel below; this shows why so much time was required for building this section. The plant now consists of one hundred twenty wells, connected by one thousand five hundred nineteen (1519) feet of twelve (12) inch suction pipe. The pumping is done by two Worthington pumps, each capable of pumping 3,000,000 gallons of water daily.

From April 5, 1895, to January 1, 1896, 814,076,753 gallons of water were pumped, and measured by a Venturi meter. The amount pumped each month was as follows:

**PUMPAGE AT THE HYDRAULIC CONSTRUCTION  
COMPANY'S WELLS, 1895.**

MONTH.	GALLONS.	REMARKS.
April .....	71,516,074	Commenced pumping April 5, 1895.
May .....	76,529,295	
June.....	70,107,764	
July .....	92,862,888	
August .....	95,203,073	
September .....	88,455,627	
October.....	102,212,358	
November.....	106,443,065	
December.....	110,746,609	
Total .....	814,076,753	

Average quantity pumped per day, 3,015,099 gallons.

The plant has never been pumped to its limit, the contract requiring not less than two, nor more than three million gallons to be pumped each and every day. The contractor has pumped, except during a break in the suction main in September, just a little over three million gallons per day.

During the great rainfall of November the valley became flooded and soon greatly increased the amount of water in the wells; this increase brought with it a large quantity of iron and lime to the wells in Section A, which made it necessary to close that portion of the plant, and it has remained closed to the present time. The analysis of the water from

this plant by the State Board of Health can be found in the annexed table on Page 111.

#### THIRD TUBE WELL PLANT.

The contract for the third tube well plant was awarded June 6, 1895, to B. F. Smith & Brother of Boston, Mass. This plant is located on a strip of land owned by the city, lying between the driveway on Pawtucket Boulevard and the Merrimack river. Mr. Andrews made his last Pawtucket Boulevard tests at this place, a record of which may be found in my report for 1892. Work was begun by Mr. Smith under his contract June 18. The first line of wells was laid out thirty-four (34) feet south of the south line of the Boulevard and parallel to it. Sixty wells were driven on this line, the wells on either end yielding so small an amount of water that the line was not extended. Twenty-six of these wells were connected temporarily and pumped four days, yielding five hundred seventy gallons per minute; during this test the ground water was lowered twelve feet.

Another line of sixty-six wells was then driven parallel to the first, and two hundred eighty (280) feet nearer the river; these wells were connected and tested in groups of twenty each, the average yield per well when pumped in this manner being twenty-five gallons per minute. Sixty-three samples of the water were collected and a chemical analysis made by Inspector Thomas O. Allen. These analyses

were made to determine the amount of free and albuminoid ammonia and iron. Samples were also sent to Mr. William P. Atwood, who returned the following report:

LOWELL, Sept. 13, 1895.

MR. GEO. BOWERS, City Engineer, Lowell, Mass.:

*Dear Sir,*—I have examined five samples of water received September 11 and 12, and submit this report:

For analytical results see sheet 1, which please find enclosed.

These waters, with the exception of No. 3, were bright and clear when received, but become slightly turbid on standing and eventually deposit a slight brownish sediment, due to the presence of a small amount of carbonate of iron in these waters.

These samples are characterized by high free ammonia and nitrates, indicating that these waters have received some organic impurity, which has been oxydized and broken up into nitrates and free ammonia.

Respectfully submitted.

W. P. ATWOOD,

*Chem. Hamilton Mfg Co.*

**WATER ANALYSIS.**

**BY WILLIAM F. ATWOOD.**

**(PARTS IN 100,000.)**

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Owing to the large amount of free ammonia and iron in the water, as shown in the chemical analysis, these wells were abandoned and the pipes pulled up. Then a line of twenty-two wells was driven at right angles to and connecting with the section above described. When these wells were tested all but five proved good. The next wells were laid out and driven in a line parallel with the other two, and one hundred seventy (170) feet south of the one first driven. In this line are one hundred twenty-two wells which have been tested in groups of from fifteen to twenty wells each. Eighty-six samples have been collected from them and analyzed by Mr. Allen, who reported them all of excellent quality. These wells are two and one-half inches in diameter, and vary in depth from twenty-seven (27) to forty (40) feet. They are all driven wells and a very large point was used to project the screens in driving. The water bearing stratum lies about twenty-five (25) feet below the surface and varies in depth from five (5) to fifteen (15) feet. The earth above this stratum is composed of very fine sand and river silt, which is almost impervious to water.

The work of driving wells is all finished, the suction mains are on the ground ready to be laid, the pumps and boilers are here ready to be set in the house which is being built for them, and very soon we shall be pumping water from this plant into the city.

Respectfully submitted,

GEORGE BOWERS. *City Engineer.*



OFFICE OF DEAN & MAIN,  
MECHANICAL AND MILL ENGINEERS,  
Exchange Building,  
53 State Street, Rooms 1027 and 1028.

BOSTON, Dec. 22, 1894.

TO THE WATER BOARD, LOWELL, MASS.:

*Gentlemen,*—On Dec. 1, 1894, I conducted a trial of the Morris pumping engine, which has recently been provided with new cylinders and valve gear by the Wheelock Engine Co. of Worcester, Mass., in order to ascertain whether it performs with the guaranteed economy. This guarantee was made in two ways, one being that the engine should use no more than 14 pounds of dry steam per indicated horse power per hour, and that it should give a duty of no less than 116,000,000 foot pounds of plunger work with a consumption of 1,000,000 British units of heat.

The trial of the engine was of 10 hours duration. A boiler trial was also carried on, the duration of which was 11.40 hours.

The feed water, the jacket, and re-heater condensations,\* and the separator condensation were weighed throughout the trial. A calorimeter was attached to the main steam pipe near the engine in order to determine the quality of the steam, and the resulting

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\*The barrel and heads of the high pressure cylinder and the heads of the low pressure cylinder were jacketed.

deduction was made both for the moisture and the steam wasted by the calorimeter.

The condensation in the separator, and leakage from a steam pipe were subtracted from the water weighed for the engine.

Ample precautions were everywhere taken to avoid or account for leakages of steam and water.

The steam used by the feed pump was furnished by a special boiler, it being considered that the boiler that drove the pumping engine should not drive the feed pump because that pump was not furnished by the Wheelock Engine Co., and because its exhaust was used for heating the building instead of raising the temperature of the feed water.

An accurate gauge gave the steam pressure at the engine, and high class thermometers the temperature of the re-heater, jacket, and air pump discharges.

Indicator diagrams were taken from each end of each steam cylinder every half hour, and observations were taken of the pressure of the water discharge main and of the distance of the gauge above the water in the suction well.

The following are the leading dimensions of the engine and boiler, one boiler being used:

#### DIMENSIONS OF THE ENGINE.

Diameter of high pressure cylinder . . . . .	20 3-4 inch.
Stroke of high pressure piston . . . . .	61.72 "
Diameter of low pressure cylinder . . . . .	41 3-16 "
Stroke of low pressure piston . . . . .	8 feet.
Diameter of high pressure piston rod . . . . .	4 3-4 inch.

Diameter of low pressure piston rod . . . . .	5 1-2 inch.
Diameter of pump bucket . . . . .	36 9-16 "
Stroke of pump bucket . . . . .	72.10 "
Ratio of piston displacements . . . . .	6.24

DIMENSIONS OF THE BOILER.

Type, horizontal return tubular.	
Number in use . . . . .	1
Inside diameter of shell . . . . .	72 inch.
Outside diameter of tubes . . . . .	3 "
Length of tubes . . . . .	16 feet.
Number of tubes . . . . .	140
Length of grate . . . . .	6 feet.
Width of grate . . . . .	6 "
Heating surface . . . . .	1,755 sq. ft.
Grate surface . . . . .	36 "
Ratio of grate to heating surface . . . . .	48.8 to 1

RESULTS OF ENGINE TRIAL.

Duration of trial . . . . .	10 hours.
Total number of revolutions . . . . .	7,842
Average number of revolutions per minute . . . . .	13.07
Average speed H. P. piston per minute . . . . .	134.45 feet.
Average speed of L. P. piston per minute . . . . .	209.12 "
Average speed of plunger per minute . . . . .	157

AVERAGE TEMPERATURES.

Of engine room . . . . .	73°
Of external air . . . . .	34°
Of air pump discharge . . . . .	75.57°
Of jacket drain . . . . .	356°
Of re-heater drain . . . . .	356°
Of water in pump well . . . . .	34°

AVERAGE PRESSURES.

Of atmosphere by barometer . . . . .	14.89 lbs.
Of steam at engine by gauge . . . . .	148.31 "
Of steam at engine absolute . . . . .	163.20 "





Vacuum by gauge . . . . .	26.9 inch.
Total head of water . . . . .	163.94 feet.
Equivalent pressure . . . . .	70.97 lbs.

STEAM USED BY ENGINE.

Total water weighed, less leakage . . . . .	35,260	lbs.
Water drained from separator . . . . .	535	"
Steam wasted by calorimeter . . . . .	821	"
Moisture in steam 0.0078 . . . . .	265	"
Total moist steam used . . . . .	33,904	"
Total dry steam used . . . . .	33,639	"
Total moist steam used by jackets . . . . .	1,481	"
Total moist steam used by re-heaters . . . . .	1,170	"
Percentage of moist steam used by jackets and re-heaters,	7.82	per cent.
Dry steam used per indicated horse-power per hour .	18.47	lbs.

BRITISH THERMAL UNITS USED BY ENGINE.

Per pound of moist steam used by cylinders . .	1,143.16	B. T. U.
Per pound of moist steam used by jackets and re-heater . . . . .	859.14	"
Total used by cylinders in 10 hours . . . . .	35,727,180	"
Total used by jackets and re-heater in 10 hours .	2,277,579	"
Total used by engine in 10 hours . . . . .	38,004,759	"

AVERAGE POWERS.

Indicated horse-power by H. P. cylinder . . . . .	84.41	I. H. P.
Indicated horse-power by L. P. cylinder . . . . .	94.70	"
Indicated horse-power by both cylinders . . . . .	182.11	"

DUTY.

Per 1,000,000 British thermal units used by the engine, based upon plunger work . . . . .	92,375,596	ft. lbs.
--	------------	----------

CAPACITY.

By plunger displacement in 24 hours . . . . .	6,167,453	gallons.
By weir measurement in 24 hours . . . . .	5,854,842	"
Slip . . . . .	5	per cent.

THE BOILER TRIAL.

Duration . . . . . 11.4 hours.

AVERAGE PRESSURES.

Steam pressure by gauge . . . . . 148.4 lbs.  
Atmospheric pressure by barometer . . . . . 14.89 "  
Absolute steam pressure . . , . . 163.29 "  
Force of draught in inches of water . . . . . 5-64 inch.

AVERAGE TEMPERATURES.

Of external air . . . . . 34°  
Of fire room . . . . . 63°  
Of escaping gases . . . . . 372°  
Of feed water . . . . . 78°

FUEL.

Total moist coal consumed . . . . . 4200 lbs.  
Moisture in coal . . . . . 2.6 per cent.  
Dry coal consumed . . . . . 4091 lbs.  
Coal equivalent of wood used . . . . . 58 "  
Dry coal including wood equivalent . . . . . 4149 "  
Total dry refuse . . . . . 347 "  
Total dry refuse . . . . . 8.36 per cent.  
Total combustible . . . . . 3802 lbs.  
Dry coal consumed per hour . . . . . 364 "  
Dry combustible consumed per hour . . . . . 334 "

QUALITY OF STEAM.

Assumed moisture . . . . . 0.0025

WATER.

Total water pumped into boiler . . . . . 35,283 lbs.  
Water evaporated corrected for quality of steam . . . . . 35,195 "  
Equivalent water evaporated into dry steam from and at 212°, 41,812 "  
Do. per hour . . . . . 3,668 "

## HEAT.

Total heat derived from fuel . . . . .	40,372,184	units.
No. of units of heat in a pound of coal by analysis,	14,241	"
No. of units of heat imparted to water per pound of coal . . . . .	9,731	"
No. of units of heat imparted to water per pound of combustible . . . . .	10,619	"
Efficiency of boiler based upon coal . . . . .	68.33	per cent.

## EVAPORATIVE PERFORMANCE.

Water actually evaporated per pound of dry coal . . . .	8.48	lbs.
Equivalent water evaporated from and at 212° . . . .	10.08	"
Water actually evaporated per pound of combustible . . . .	9.26	"
Equivalent water evaporated from and at 212° . . . .	11.00	"

## RATE OF COMBUSTION.

Dry coal actually burned per square foot of grate surface per hour . . . . .	10.11	lbs.
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## RATE OF EVAPORATION.

Water evaporated from and at 212° per square foot of heating surface per hour . . . . .	2.09	lbs.
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## COMMERCIAL HORSE-POWER.

On the basis of evaporating 34 1-2 lbs. of water per hour from and at 212° . . . . .	106	H. P.
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## COMMENTS UPON THE RESULTS.

The actual consumption of dry steam by the engine was 18.47 lbs. per indicated horse power, while the guaranteed consumption is 14 lbs. The excess used is, 18.47 lbs.—14 lbs.=4.47 lbs., or 31.93 per cent. too much. The duty obtained was 92,375,596 foot pounds, while that guaranteed is 116,000,000 foot



pounds. The duty therefore is less than the guaranteed amount by 116,000,000 ft. lbs.—92,375,596 ft. lbs.=23,624,404 ft. lbs., or 20.36 per cent.

The evaporative performance of the boiler is poor and should easily be at least 5 per cent. greater with the quality of coal used, which was excellent. The boiler was worked at a very economical rate, and the firing should be watched for imperfections of method.

Respectfully submitted,

F. W. DEAN.

OFFICE OF DEAN & MAIN,  
MECHANICAL AND MILL ENGINEERS.  
Exchange Building,  
53 State Street, Rooms 1027 and 1028.

BOSTON, Oct. 10, 1895.

TO THE WATER BOARD, LOWELL, MASS.:

*Gentlemen*,—On Sept. 24, 1895, Mr. Dean conducted a second duty trial of the so-called Morris pumping engine, at the pumping station of the City of Lowell for the purpose of ascertaining whether the engine is performing the guaranteed duty of 116,000,000 foot pounds per 1,000,000 British thermal units consumed, or whether the engine uses as little as 14 pounds of dry steam per indicated horse-power per hour.





- As this trial was strictly a water weighing trial, and could therefore be made with accuracy for any length of time, eight hours was considered to be of sufficient length. The engine was run for an hour before the trial began, at its regular working speed and pressure, and thus was thoroughly heated through in all parts before the trial began. It was also kept running for some time after the trial ended under full pressure and speed in order to maintain proper conditions from beginning to end. The trial proper began with a running start and ended 8 hours, 0 minutes, 15 seconds later, at which time the height of the water in the boiler was the same as at the beginning, and the steam pressure within 1 pound of that at the beginning.

The feed water, jacket and re-heater condensations, and separator condensations were weighed. No calorimeter was attached to the steam pipe, the moisture in the steam being assumed to be the same as that found in the trial of Dec. 1, 1894.

Leakages of feed water in various places were caught and allowed for. As in the other trial the steam used by the feed pump was furnished by an independent boiler.

The steam pressure in the steam pipe was taken near the engine by a nice test guage, the error of which was determined immediately after the trial, and correct thermometers were used for determining the temperatures of the feed water, jacket and re-heater discharge, and pump well water. The water

pressure in the engine discharge main was determined by a fine test guage having an error that was determined afterward. The height of the centre of this guage above the water in the suction well was read from a graduated float rod.

Indicator diagrams were taken once an hour.

The leading dimensions of the engine and boiler will be found in the report of the test of Dec. 1, 1894.

The following are the results of this trial:

RESULTS OF ENGINE TRIAL.

Date . . . . .	Sept. 24, 1895.
Duration of trial . . , . .	8 hours.
Total number of revolutions . . . . .	5,826 revs.
Average number of revolutions per minute . . . . .	12.14 "
Average speed of H. P. piston per minute . . . . .	124.88 feet.
Average speed of L. P. piston per minute . . . . .	194.20 "
Average speed of plunger per minute . . . . .	145.88

AVERAGE TEMPERATURES.

Of engine room . . . . .	79°
Of external air . . . . .	67°
Of air pump discharge . . . . .	94.6°
Of jacket and re-heater drain . . . . .	356°
Of water in pump well . . . . .	66.4°

AVERAGE PRESSURES.

Of atmosphere by barometer . . . . .	14.9 lbs.
Of steam at engine by gauge . . . . .	147.8 "
Of steam at engine absolute . . . . .	162.7 "
Vacuum by gauge . . . . .	25.75 inch.
Total head of water . . . . .	165.05 feet.
Equivalent pressure . . . . .	71.45 lbs.

## STEAM USED BY ENGINE.

Total water weighed . . . . .	22,611	lbs.
Leakages . . . . .	60	"
Separator drain . . . . .	376	"
Net moist steam used by engine . . . . .	22,175	"
Rate of moisture in steam (assumed from test of Dec.		
1, 1894 . . . . .	0.0078	
Total moisture in steam . . . . .	173	lbs.
Net dry steam used . . . . .	22,002	"
Moist steam used by jackets and re-heater . . . . .	2,346	"
Percentage of moist steam used by jackets and re-heater,	10.58	per cent.
Dry steam used per indicated horse-power per hour . .	16.14	lbs.

## BRITISH THERMAL UNITS USED BY ENGINE.

Per pound of moist steam used by cylinders . .	1,123.92	B. T. U.
Per pound of moist steam used by jackets and		
re-heater . . . . .	858.84	"
Total used by cylinders in 8 hours . . . . .	22,286,210	"
Total used by jackets and reheater in 8 hours .	2,014,839	"
Total used by engine in 8 hours . . . . .	24,301,049	"
Total used by engine per indicated horse-power		
per minute . . . . .	297.1	"
Thermal efficiency of engine . . . . .	14.29	per cent.

## AVERAGE POWERS.

Indicated horse-power by H. P. cylinder . . . . .	79.94	H. P
Indicated horse-power by L. P. cylinder . . . . .	90.48	"
Indicated horse-power by both cylinders . . . . .	170.42	"
Percentage of horse-power by H. P. cylinder . . .	46.9	per cent.
Percentage of horse-power by L. P. cylinder . . .	53.1	"
Pump horse-power . . . . .	165.77	H. P.
Friction horse-power . . . . .	4.65	"
Friction of mechanism . . . . .	2.78	per cent.

## DUTY.

Per 1,000,000 British thermal units used by the	
engine, based upon plunger work . . . . .	108,056,120 ft. lbs.

## CAPACITY.

By plunger displacement in 24 hours . . . . .	5,727,438 gallons.
Slip (assumed as determined on Dec. 1, 1894) . . . .	5 per cent.
Delivery into force main, based on 5 per cent. slip .	5,441,000 gallons.

## COMMENTS ON THE RESULTS.

The dry steam used per indicated horse-power per hour was 16.14 pounds, and that guaranteed being 14 pounds, the excess consumed is 16.14 lbs. -- 14 lbs. = 2.14 lbs., or 15.3 per cent. too great.

The duty obtained was 108,056,120 foot pounds, while that guaranteed was 116,000,000 foot pounds. The deficiency is therefore 7,943,888 foot pounds, or 6.85 per cent.

These results, while a great gain over those of the last trial, are, unfortunately, too low for a high-class engine such as this is, and are undoubtedly due to leakages of steam by the steam valves and seats into one or both cylinders.

Respectfully submitted,

DEAN & MAIN.

**Commonwealth of Massachusetts.—State Board of Health, Lowell.**

**WATER**

(PARTS

13,000	Jan., 1895. 15 16	Slight milky.	Slight.	0.30	Distinctly musty and disagreeable.	Decid'ly mus- ty & disagree- able, almost offensive.	4.25	1.25	3.00	.0076	.0174	.0148	.0026	.29	.0040	.0000	1.4	.0000	.4345	Merrimack River.
13,843	Feb. 19 19	Dist't.	Slight.	0.28	Distinctly musty and disagreeable.	Decidedly offensive.	4.35	1.35	3.00	.0084	.0158	.0140	.0018	.25	.0050	.0000	1.4	.0160	.4332	"
13,990	March 19 20	Slight.	Cons. dark brown.	0.48	Distinctly musty and disagreeable.	Decidedly musty and disagreeable.	3.40	1.15	2.25	.0020	.0166	.0134	.0032	.17	.0070	.0001	0.8	.0085	.5925	"
14,163	April 16 17	Dec'd clayey.	Consid'ly earthy.	0.53	Faintly vege- table and unpleasant.	Decidedly musty and disagreeable.	3.40	1.35	2.05	.0008	.0286	.0134	.0169	.13	.0100	.0001	1.5	.0375	.6636	"
14,335	May 21 21	Slight.	Consid'ly	0.33	Faintly vegetable.	Distinctly vegetable.	3.25	1.35	1.90	.0014	.0128	.0083	.0040	.17	.0060	.0001	1.3	.0135	.5016	"
14,491	June 18 19	Dist't.	Slight.	0.27	Faintly vegetable.	Faintly vegetable.	3.65	1.55	2.10	.0006	.0106	.0124	.0072	.20	.0050	.0002	0.8	.0230	.3838	"
14,634	July 22 23	Dist't.	Consid'ly	0.33	Faintly vegetable and musty.	Distinctly musty.	4.40	1.85	2.55	.0024	.0202	.0148	.0054	.23	.0080	.0004	1.4	.....	.4950	"
14,870	Aug. 20 20	Dist't.	Slight.	0.33	Faintly vegetable	Faintly vegetable and musty.	4.45	2.10	2.35	.0028	.0150	.0118	.0032	.23	.0050	.0001	0.9	.....	.3688	"
15,183	Sept. 17 18	Slight.	Slight.	0.23	Distinctly mouldy	Distinctly vegetable and musty.	3.55	1.05	2.50	.0066	.0170	.0154	.0016	.96	.0030	.0001	1.6	.....	.9471	"
15,300	Oct. 15 16	Dist't.	Consid'ly	0.60	Distinctly vegetable.	and grassy.	4.55	1.80	2.75	.0000	.0258	.0198	.0000	.31	.0070	.0001	1.6	.....	.8034	"
15,570	Nov. 20 20	Slight.	Slight.	0.72	Distinctly vegetable and musty.	Distinctly vegetable and musty.	3.05	1.55	2.10	.0004	.0212	.0162	.0050	.19	.0070	.0000	1.1	.....	.8409	"
15,752	Dec. 17 18	Slight.	Slight.	0.40	Distinctly vegetable and mouldy.	Distinctly vegetable and disagreeable.	3.75	1.60	2.15	.0080	.0156	.0144	.0012	.14	.0120	.0001	1.1	.....	.5986	"



## CAPACITY.

By plunger displacement in 24 hours . . . . .	5,727,438	gallons.
Slip (assumed as determined on Dec. 1, 1894) . . . . .	5	per cent.
Delivery into force main, based on 5 per cent. slip . . . . .	5,441,000	gallons.

## COMMENTS ON THE RESULTS.

The dry steam used per indicated horse-power per hour was 16.14 pounds, and that guaranteed being 14 pounds, the excess consumed is 16.14 lbs.—14 lbs. = 2.14 lbs., or 15.3 per cent. too great.

The duty obtained was 108,056,120 foot pounds, while that guaranteed was 116,000,000 foot pounds. The deficiency is therefore 7,943,888 foot pounds, or 6.85 per cent.

These results, while a great gain over those of the last trial, are, unfortunately, too low for a high-class engine such as this is, and are undoubtedly due to leakages of steam by the steam valves and seats into one or both cylinders.

Respectfully submitted,

DEAN & MAIN.

## Commonwealth of Massachusetts.—State Board of Health, Lowell.

## WATER ANALYSIS.

(PARTS IN 100,000.)

No.	DATE OF		APPEARANCE.			ODOR.		RESIDUE ON EVAPORATION				AMMONIA.			Chlorine.	NITROGEN AS	Hardness.	Iron.	Oxygen Consumed	REMARKS.
	Col- lec- tion.	Ex- am- ina- tion.	Turbid- ity.	Sediment.	Color	Cold.	Hot.	Total.	Loss on Igni- tion	F C H F	S L S	Albuminoid.								
												Total	In so- lution, percent							
13,800	Jan., 1888. 15 16		Slight milky.	Slight.	0.30	Distinctly musty and disagreeable.	Deci- ty & able off	4.25	1.25	3.00	.0078	.0174	.0148	.0028	.28	.0000	1.6	.0030	.4345	Merrimack River.
13,843	Feb. 19 19		Dist't.	Slight.	0.28	Distinctly musty and disagreeable.	De- mu- diag	4.35	1.35	3.00	.0084	.0158	.0140	.0018	.25	.0000	1.4	.0160	.4339	"
13,900	March 19 20		Slight.	Cons. dark brown.	0.43	Distinctly musty.	De- mu- diag		2.25		.0029	.0180	.0134	.0032	.17	.0001	0.8	.0065	.5925	"
14,153	April 16 17		Dec'd clayey.	Consid'bly earthy.	0.53	Faintly vege- table and unpleasant.	De- mu- diag				.0008	.0208	.0134	.0182	.13	.0001	1.5	.0375	.6538	"
14,335	May 21 21		Slight.	Consid'bly	0.39	Faintly vegetable.	Dis- veg				.0014	.0128	.0088	.0040		.0001	1.3	.0135	.5016	"
14,431	June 18 19		Dist't.	Slight.	0.37	Faintly vegetable.	F veg				.0008	.0188	.0124	.0072		.0002	0.8	.0250	.3633	"
14,634	July 22 23		Dist't.	Consid'bly	0.33	Faintly vegetable and musty.	Dis- n				.0024	.0203	.0148	.0054		.0004	1.4	.....	.4950	"
14,870	Aug. 20 20		Dist't.	Slight.	0.33	Faintly vegetable.	F veg and				.0028	.0150	.0118	.0032		.0001	0.9	.....	.3586	"
15,183	Sept. 17 18		Slight.	Slight.	0.22	Distinctly mouldy.	Dis- veg and	3.55	1.05	2.50	.0036	.0170	.0134	.0016		.0001	1.6	.....	.3471	"
15,269	Oct. 15 16		Dist't.	Consid'bly	0.60	Distinctly vegetable.	Fain- tal	4.55	1.30	2.75	.0000	.0258	.0128	.0050		.0001	1.6	.....	.8034	"
15,570	Nov. 20 20		Slight.	Slight.	0.72	Distinctly vegetable and musty.	Dis- veg and	3.65	1.55	2.10	.0004	.0212	.0102	.0050		.0000	1.1	.....	.8409	"
15,752	Dec. 17 18		Slight.	Slight.	0.40	Distinctly vegetable and mouldy.	Dis- mu- diag	3.75	1.60	2.15	.0060	.0156	.0144	.0012		.0001	1.1	.....	.5286	"

**Commonwealth of Massachusetts.—State Board of Health, Lowell**

**WATER ANALYSIS.**

(PARTS IN 100,000.)

**Commonwealth of Massachusetts. — State Board of Health, Lowell.**

**WATER ANALYSIS.**

(PARTS IN 100,000.)







1000





**TWENTY-FOURTH**

**ANNUAL REPORT**

**OF THE**

**LOWELL WATER BOARD**

**TO THE**

**CITY COUNCIL OF THE CITY OF LOWELL, MASS.,**

**AND THE**

**REPORTS OF THE SUPERINTENDENT OF WATER WORKS**  
**AND OF THE CITY ENGINEER TO THE**  
**WATER BOARD FOR 1896.**

**LOWELL, MASS. :**  
**BUTTERFIELD PRINTING AND BINDING COMPANY.**  
**1897.**

142844

1897  
905

CITY OF LOWELL.

---

IN BOARD OF ALDERMEN, February 1, 1897.

Received and ordered on file; sent down for concurrence.

GIRARD P. DADMAN, *City Clerk*.

---

IN COMMON COUNCIL, February 1, 1897.

Received and ordered on file, in concurrence.

FRANK N. OWEN. *Clerk*.

# WATER DEPARTMENT, 1896.

## WATER BOARD.

GEORGE E. PUTNAM, *President.*

Term expires second Monday in March, 1897.

AUGUST FEIS,

Term expires second Monday in March, 1898.

STEPHEN H. JONES,

Term expires second Monday in March, 1899.

FRANK L. WEAVER,

Term expires second Monday in March, 1900.

CHARLES E. HOWE,

Term expired first Monday in January, 1897.

J. W. CRAWFORD, *Secretary and Clerk.*

---

ROBERT J. THOMAS, *Superintendent.*

GEORGE BOWERS, *City Engineer.*

---

D. B. H. BARTLETT, *Engineer.*

WILLIAM JOYCE, *Asst. Foreman.*

THOMAS McLOUGHLIN, *Engineer.*

JOHN E. LOWNY, *Meters.*

FRANK LAPOINT, *Reservoir.*

ARTEMAS S. YOUNG, *Foreman Shop.*

THOMAS F. DOYLE, *Foreman.*

A. F. COGER, *Hydrants and Gates.*

THOMAS ROGERS, *Services.*

---

## OFFICE.

LEONARD T. FARRIS, *Service Clerk.*

GERTRUDE W. BYAM, *Bookkeeper.*

JULIA J. RAFTER, *Asst. Bookkeeper.*

---

## INSPECTORS.

ROBERT GARDNER, JR.

MICHAEL H. McCUE.

GEORGE E. WORTHEN.

GEORGE F. TILTON.

WALTER P. WILEY.



# REPORT OF THE WATER BOARD.

OFFICE OF THE WATER BOARD,  
CITY HALL,  
LOWELL, MASS., Jan. 11, 1897.

*To His Honor the Mayor and the City Council of the City of Lowell.*

In compliance with the requirements of the city ordinances, the Water Board herewith present the twenty-fourth annual report of the Water Board for the year ending December 31st, together with the superintendent's report of the operations and improvements made in the department during the year.

There was but one change in the personnel of the board from the previous year, Mr. Charles E. Howe succeeding Mr. William L. Hills as the member from the board of aldermen. Mr. Frank L. Weaver having been elected by the city council to succeed himself for the full term.

The board organized by re-electing Mr. Putnam president, and Mr. Thomas superintendent, and elected Mr. Crawford clerk and secretary of board.

On February 28th Smith Brothers commenced pumping water into the city main at the Boulevard plant, on the year's test, but on March 2d were compelled to stop owing to high water in the Merrimack river which flooded the station, and

owing to the collapse of a portion of the conduit no water could be run through it.

But on April 17th pumping was resumed and has continued ever since and has delivered an average of nearly four million gallons of water per day.

The break in the conduit was discovered on March 4th at a point in the tunnel near where Moody street extension crosses Gershom avenue, where a shaft was put down through the rock and then bricked up and backfilled, the bottom of the tunnel being about forty feet below the surface, and was caused by the forming of a large body of water on the surface, backed up by the Moody street extension forming a dam across the way, without means of escape except by percolation, and owing to improper backing of the brickwork the water got in behind it causing it to cave in. The brickwork was replaced by 48'' cast iron pipe with a 48'' manhole so that now the tunnel can be entered midway of its length for repairs or inspection. The cost of the repairs was :

For Labor . . . . .	\$6,160.20
Material . . . . .	3,344.93
	<hr/>
	\$9,505.13
Deduct one-half cost of lumber used for other purposes afterwards . . . . .	\$ 412.88
	<hr/>
	\$9,092.25

During the period from March 4th to April 17th the city was dependent upon the well plants on the south side of the city and the reservoir, for the water supply, during which time the reservoir was lowered about five feet.

On March 27th the crank pin on the Morris engine broke while the engine was running, causing considerable damage to the engine, breaking the base of each cylinder, necessitating the putting in of new ones by the American Wheelock Engine

Co., but the labor has all been done by the regular employes of this department, and the engine was made ready to run again August 22d. The cost of the repairs, exclusive of the labor as above, has been \$1,129.01.

On April 2d, Mr. Washington of the Hydraulic Construction Company announced to the board that he was ready to turn over to the city the pumping plant in Chelmsford which he had maintained for one year in accordance with the terms of the contract. He presented a schedule of the property at the station showing the cost, which was verified by the city engineer both as to articles enumerated and cost of same, showing the cost of the station to have been \$10,712.32. A claim was also made for a further sum for excessive pressure over contract specifications, also for the cost of a new water end to Worthington pump claimed to have been broken by said extra pressure, but these claims were not allowed and a settlement was effected upon following terms :

Pumping plant . . . . .	\$ 8,000.00
Fourth payment 25% on two million galls. .	9,874.50
Full payment on one million galls. . . . .	19,749.00
	<hr/>
	\$37,623.50
Less amount advanced for tests . . . . .	2,500.00
	<hr/>
	\$35,123.50

And the city assumed charge of the plant Friday, April 24th, 1896. During the summer considerable work has been done on the premises, putting everything on a more permanent basis, and a coal bin was built with lumber that had been used on the conduit repairs.

Early in the year it was determined by the board to place meters on to property where it was known that large quantities of water was being wasted, including twenty-five bar-rooms, fourteen stables and some of the large blocks. Ninety meters



were thus placed, which showed a saving of 60,000 gallons of water per day in the second quarter. A few examples of what the meters found follow. The first column showing the amount charged on rates, the second the rate at which the meter showed the water was being used in the first quarter, and the next column shows the same for the second quarter. These are a few of the extreme cases, and is evidence of the cost to the city through indifference or penuriousness, where through defective plumbing the water is allowed to run to waste at from five to ten times the amount paid for, but when compelled to pay for it a remedy is applied with the result of a saving in water bills, and no one will believe that the result is obtained by any restriction in the legitimate use of the water; the water was simply wasted, and brought good to nobody. The list shows a great decrease in the amount of water in the second quarter, and in most cases at a rate which would make the yearly amount paid less than the faucet rate, except in the case of the bar-rooms, where small moters are used to run the beer pumps and use a great deal of water. Hereafter no bar-room will be furnished with water except through a meter.

	Yearly rates.	Meter per yr. by 1st qr.	Meter per yr. by 2d qr.
13 families, 2 stores.....	\$144.00	\$444.00	\$106.96
4 families, 1 market.....	34.50	123.96	30.24
6 families.....	62.00	211.32	33.04
7 families.....	73.00	392.64	52.64
7 families, photo. gal., boarding h's'e.	190.00	885.20	185.84
4 families, large boarding houses....	110.50	356.64	104.72
2 families, boarding houses.....	52.00	205.08	28.00
2 families, bar and laundry..	80.00	158.80	73.36
8 families.....	64.00	360.08	31.36
1 family, bar.....	42.00	293.76	179.60
1 bar and restaurant....	72.00	275.92	275.92
1 family and bar.....	28.00	128.80	128.80
6 families.....	72.00	997.84	417.12

1 family and bar.....	\$41.25	\$130 20	\$130 20
13 families.....	147.00	316 00	125.00
4 families.....	34 50	125.44	21.28
4 families and bar.....	55.00	173.92	73.92
5 families and stable.....	49.50	373.44	23.52
1 family, bar, bottling establishment.	51.00	263 00	175.84
Bar, 6 stores, laundry.....	120.50	318.24	429.12
2 families.....	26.00	130.20	25.20
5 families.....	56.00	591.84	115.74
Bar and photograph gallery.....	52.00	184.28	319.76

In August a settlement was effected with Mr. P. H. Rafter whereby the city became owner of the 2.65 acres of land at Station No. 3 for \$500 ; this completes the city's ownership of all the land occupied at this station.

As a result of the opening of the Moody street bridge, the land through which the water works conduit passes has come into the market, and in two instances houses have been built directly over the tunnel on Gardner avenue and close to the manhole where occurred the break in the tunnel. The water board upon learning of these preparations, visited the premises and voted to instruct the city solicitor to ask the court for an injunction enjoining any one from building upon the line of the conduit, and the matter remains in the hands of the city solicitor for final settlement.

The importance of a system of sewerage for this rapidly growing section, with the use of iron pipe in the vicinity of the conduit line, cannot be too strongly urged, as an aid to the maintenance of a pure water supply. The whole water supply for the city since the 22d day of February, 1896, has been obtained from the wells, and the city is wholly independent of the river for its water, and the supply is adequate for a long time if the consumption can be kept within the bounds of legitimate use by metering ; if not so restricted it will be necessary to increase the supply within a short time. The agita-

tion of the meter question last year resulted in a large increase in the application for new meters, there having been over 500 new meters set exclusive of the ninety city meters, a reduction in the price of meters and an awakening to the economy of paying meter rates instead of faucet rates was responsible.

To obviate the many complaints of dirty water caused by the varying pressure resulting from pumping directly into the mains, it will be necessary to lay a new force main connecting the wells on the south side of the city with the reservoir, thereby maintaining a steady and even pressure in the pipes, avoiding the stirring up of the water in the pipes by changing currents.

The finances of the department as shown in the secretary's report, show the usual gratifying increase as follows :

Charged for water . . . . .	\$230,507.88
Other charges . . . . .	17,533.48
Transfer account from 1895 . . . . .	32,571.09
	<hr/>
	\$280,612.45
Collections . . . . .	\$219,000.19
Discounts . . . . .	22,898.25
Abated . . . . .	10,017.73
Uncollected, to 1897 . . . . .	28,696.28
	<hr/>
	\$280,612.45
The charges for water by meter increased .	\$11,684.76
The charges for water by rate increased .	391.59
	<hr/>
	\$12,076.35
Other charges decreased . . . . .	\$2,791.36
	<hr/>
Net increase over 1895 . . . . .	\$9,284.99

The income exceeded the out-go for the year by \$5,393.40. The extraordinary expenses were the repairs to the conduit, and \$3700 for new 10'' and 12'' pipe in anticipation of the grading of Princeton street. The balance to 1897 is \$36,279.81.

The great increase in the amount of abatements, being \$10,017.73 against \$3,428.99 in 1895, was caused by the great number of people who waited until receiving their annual rate bill before applying for a meter, and then the rate bill has to be abated from the time the meter is set.

The driven well balance Jan. 1, 1896, was.....	\$59,312.58
Expended at "Chelmsford Plant".....	\$36,381.58
"Boulevard Plant".....	18,852.98
	<hr/>
	\$55,234.56
Balance, 1897.....	<hr/> \$4,087.02

The secretary's report will show the details of receipts and expenditures more fully. In conclusion, the Water Board desires to congratulate the citizens of Lowell on the success attending the efforts to procure an adequate supply of ground water, and to testify to the faithful and intelligent services rendered by Superintendent Thomas and Engineer Bowers toward that end.

GEORGE E. PUTNAM,  
AUGUST FELS,  
S. H. JONES,  
FRANK L. WEAVER,  
CHARLES E. HOWE.

LOWELL WATER WORKS OFFICE,  
January 1st, 1897.

TO THE LOWELL WATER BOARD:

*Gentlemen:*—Herewith I submit figures detailing the finances of the Lowell Water Works for the year ending December 31st, 1896.

J. W. CRAWFORD, *Clerk.*

TABLE I.

FINANCIAL STATEMENT — LOWELL WATER WORKS, 1898.

RECEIPTS.									
By Accounts.									
	Receipts.	Discounts.	Abatements.	Due.					
Transfer.....	\$28,282.74	\$ 2,597.22	\$ 858.32	\$ 832.81					
January.....	2,342.86 *3.80	27.57	21.80	32.53					
February.....	934.61	3.81	41.10	27.38					
March.....	114,928.40	13,450.59	8,159.24	192.18					
April..	2,263.10	89.43	75.27	79.61					
May.....	4,203.16	279.63	78.26	110.14					
June.....	31,227.65	3,239.83	359.97	159.53					
July.....	2,080.14	62.57	76.03	20.99					
August.....	2,196.30	54.57	65.61	51.14					
September.....	27,892.73	2,961.12	263.17	252.22					
October.....	996.88	25.56	12.71	1,094.98					
November.....	431.13	4.50	6.25	892.17					
December.....	1,220.49	101.85	.....	24,950.60					
Totals.....	\$219,003.99	\$22,898.25	\$10,017.73	\$28,696.28					

CHARGES.						
	Water.		Other than water.	Total Charges 1896.	Total Charges 1895.	
	Metered.	Total.				
Transfer.....				\$32,571.09	\$28,181.95	
January.....	\$ 37.10	\$ 160.96	\$ 2,263.80	2,424.76	655.51	
February.....		37.24	969.66	1,006.90	1,643.18	
March.....	24,576.45	136,730.41		136,730.41	132,190.07	
April..		866.64	1,640.77	2,507.41	4,267.41	
May.....			1,882.93	4,671.19	4,244.29	
June.....	31,742.39	32,508.25	2,478.73	34,986.98	30,885.37	
July.....		608.75	1,630.98	2,239.73	2,660.02	
August.....	124.46	511.15	1,856.47	2,367.62	4,578.63	
September.....	29,349.20	29,645.16	1,724.08	31,369.24	27,633.03	
October.....		746.71	1,383.42	2,130.13	2,795.82	
November.....		147.37	1,186.68	1,334.05	2,358.58	
December.....	25,447.51	25,756.98	515.96	26,272.94	24,844.56	
Totals.....	\$111,277.11	\$230,507.88	\$17,533.48	\$280,612.45	\$266,938.42	

\* \$3.80 received in April is cash returned to Water Works account on pay-roll.

TABLE II.

FINANCIAL STATEMENT—LOWELL WATER WORKS, 1896.  
OUTGO.

	Pay Rolls and Salaries.	Water Works Supplies.	Interest and Principal	Refunds and Va- cancies.	General Expense Account.	Stable De- partm't.	Reservoir De- partm't.	Morris Engine Repairs.	COAL.			Pumping Well Water.	TOTALS.	
									P. S. 1.	P. S. 2.	P. S. 3.		1896.	1895.
January.....	\$4,068.81	\$1,623.35	\$320.00	\$91.52	\$393.56	\$175.88	\$8.40	....	....	\$ 196.74	....	\$2,329.40	\$ 9,207.66	\$13,175.93
February.....	4,116.50	5,972.42	8 287.50	19.51	105.79	247.39	19.50	....	....	....	....	1,519.98	20,288.59	12,658.10
March.....	6,199.90	4,501.71	1,320.00	....	775.31	60.15	....	....	....	....	....	1,742.45	14,599.52	6,830.66
April.....	5,244.27	9,448.15	200.00	8.60	471.91	120.74	90.80	\$275.57	....	2,789.11	\$ 282.59	1,119.06	20,000.80	8,769.19
May.....	7,894.50	3,516.68	18,720.00	1,066.49	376.65	150.65	77.02	27.88	\$528.43	....	....	1,196.08	33,554.38	84,160.17
June.....	5,684.08	3,341.24	1,400.00	111.59	273.93	180.37	15.80	63.63	2,534.08	953.48	1,835.90	1,359.14	17,753.24	14,025.08
July.....	4,927.04	2,879.75	10,440.00	194.30	294.18	111.64	....	6.15	....	....	....	1,521.00	20,374.06	22,718.71
August.....	5,676.56	2,102.56	2,967.50	238.07	407.99	124.69	....	27.19	....	....	1,723.57	1,431.04	14,699.17	15,755.57
September.....	4,725.10	844.94	600.00	22.94	181.70	21.50	4.94	....	....	....	....	1,248.59	7,649.71	10,842.99
October.. ..	5,483.96	1,843.62	11,440.00	188.30	171.32	192.41	....	728.59	....	....	....	1,005.49	21,053.69	10,107.97
November.....	4,625.24	1,220.79	19,880.00	33.30	210.52	100.38	....	....	....	....	....	996.46	27,066.69	36,879.77
December.....	3,486.19	1,660.74	1,520.00	....	61.58	80	....	....	....	....	....	633.77	7,363.08	22,689.93
Totals.....	\$62,132.15	\$38,955.95	\$77,095.00	\$1,974.62	\$3,724.44	\$1,486.60	\$216.46	\$1,129.01	\$3,062.51	\$3,939.33	\$3,792.06	\$16,102.46	\$213,610.59	\$207,614.07

TABLE III.

FINANCIAL STATEMENT—LOWELL WATER WORKS, 1893.

SUBDIVISION OF "OTHER THAN WATER CHARGES" FROM TABLE I.

	Meters Sold.	Expense Setting Meters.	Meter Repairs.	New Services.	Relaid Services.	Labor and Material.	Lime Charges.	Shut-off Tees.	Sewer Flushing.	Totals.	
										1896.	1895.
January.....	\$ 647 00	\$ 41 59	\$ 19 07	\$118 97	\$ 36 65	\$1,259 08	\$129 44	\$4 00	\$ 8 00	\$2,263 80	\$ 593 44
February.....	738 00	47 04	36 25	36 85	20 47	76 15	90	2 00	12 00	969 66	1,643 18
March.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
April.....	1,077 00	77 63	13 83	272 93	76 54	66 18	48 66	8 00	.....	1,640 77	2,475 70
May. ....	1,138 00	81 89	1 58	385 32	98 07	108 09	65 98	4 00	.....	1,882 93	1,733 33
June .....	1,632 00	158 10	1 58	327 80	209 64	104 73	38 88	2 00	4 00	2,478 73	1,672 46
July.....	911 50	98 82	13 83	264 84	135 32	76 95	51 72	66 00	12 00	1,630 98	1,698 38
August.....	1,145 50	135 19	.....	262 22	191 20	62 92	41 44	6 00	12 00	1,856 47	3,791 57
September...	691 50	73 33	1 80	302 56	122 07	430 28	84 54	14 00	4 00	1,724 08	1,588 32
October.....	660 50	74 17	12 33	287 90	91 19	192 01	49 32	8 00	8 00	1,383 42	2,424 44
November...	517 00	52 21	.....	311 78	211 33	25 16	55 20	2 00	12 00	1,186 68	1,909 50
December....	193 00	15 26	4 13	135 55	58 81	65 65	19 56	24 00	.....	515 96	794 52
Totals...	\$9,351 00	\$855 23	\$104 40	\$2,706 72	\$1,251 29	\$2,467 20	\$585 64	\$140 00	\$72 00	\$17,533 48	\$20,324 84



TABLE IV.

FINANCIAL STATEMENT—LOWELL WATER WORKS, 1896.

SUBDIVISION OF "PAY ROLLS AND SALARIES" FROM TABLE II.

	Salaries President Superin- tendent.	Office and Inspector.	New Meter Work.	Meter Repairs.	Extension and Construc'n.	Pumping.		Maintenance.		Reer- voir.	New Services.	Relaid Services.	Recharged Sundry Persons.	Totals.	
						Station I.	Driven Wells.	Old System.	Wells.					1896.	1896.
January .....	.....	\$ 698 81	\$140 50	\$140 50	\$ 688 03	\$287 81	\$435 41	\$1,277 29	\$ 87 44	\$ 67 03	\$116 68	\$ 31 50	\$108 81	\$4,068 31	\$4,994 08
February .....	\$ 866 67	698 00	77 25	130 00	159 95	319 08	388 60	1,240 67	363 95	81 20	34 75	40 63	220 75	4,116 50	2,960 63
March.....	183 33	558 40	122 75	129 75	84 16	334 61	284 79	4,198 03	191 02	45 92	15 00	.....	52 14	6,199 90	3,434 92
April .....	183 33	581 36	109 00	87 25	314 02	337 29	282 80	2,804 78	119 40	111 92	169 37	90 80	53 00	5,244 27	4,397 57
May .....	183 34	726 70	140 88	119 50	1,617 99	535 55	712 46	2,558 53	423 78	177 40	354 97	312 77	30 63	7,894 50	5,578 04
June.....	183 33	638 75	199 00	144 00	1,384 00	417 36	558 16	1,447 61	87 50	98 42	287 45	222 25	16 25	5,684 08	5,358 11
July .....	183 33	657 88	92 88	136 52	579 77	439 52	586 39	1,360 74	358 25	45 92	224 90	187 25	123 69	4,927 04	4,389 20
August .....	183 34	822 35	106 19	165 25	1,029 42	567 56	759 51	1,371 64	117 61	57 40	273 50	195 54	27 25	5,676 16	5,724 13
September.....	183 33	657 88	73 81	152 44	713 46	438 28	577 53	1,883 54	55 50	61 12	231 85	163 06	33 30	4,725 10	4,752 64
October.....	183 33	822 35	116 25	243 00	777 86	555 19	810 54	1,411 01	.....	71 30	279 63	190 00	23 50	5,483 96	4,908 12
November .....	183 34	665 88	117 25	160 25	681 40	447 94	655 92	1,225 09	15 00	45 92	241 75	172 50	13 00	4,625 24	4,619 40
December .....	633 33	499 41	103 75	129 75	111 62	332 23	502 35	796 04	65 50	55 94	154 67	91 75	9 75	3,486 19	2,612 24
Totals .....	\$2,650 00	\$8,027 27	\$1,399 51	\$1,738 21	\$8,136 68	\$5,012 02	\$6,549 46	\$21,074 92	\$1,884 95	\$919 49	\$2,379 52	\$1,648 05	\$712 07	\$62,132 15	\$53,729 08

TABLE V.

## FINANCIAL STATEMENT—LOWELL WATER WORKS, 1896.

SUBDIVISION "WATER WORKS SUPPLIES"  
FROM TABLE II.

Pumping Station, No. 1, supplies.....	\$ 1,493.01
Pumping Station, No. 2, supplies.....	630.73
Pumping Station, No. 3, supplies.....	894.85
Iron pipe and specials.....	12,838.48
Hydrants.....	1,199.82
Gates, valves, and brass fittings.....	1,377.84
Lead pipe, pig lead and solder.....	1,666.86
Meters.....	9,700.54
Sidewalk and gate boxes.....	1,340.05
Conduit.....	3,344.93
Miscellaneous stock.....	3,896.16
Machinery and tools.....	572.68
Total.....	<hr/> \$38,955.95

## TABLE VI.

## FINANCIAL STATEMENT—LOWELL WATER WORKS, 1896.

DETAIL OF "PRINCIPAL AND INTEREST"  
FROM TABLE II.

## WATER LOAN BONDS:

Coupon No. 8, Nov., 1894, 5 @ 20.....	\$ 100.00	
No. 9, May, 1895, 10 @ 20.....	200.00	
No. 10, Nov., 1895, 48 @ 20.....	960.00	
No. 11, May, 1896, 984 @ 20.....	19,680.00	
No. 12, Nov., 1896, 923 @ 20.....	18,460.00	
	<hr/>	\$39,400.00

## HIGH SERVICE LOAN:

Coupon, No. 29, 15 @ 100.....	\$ 1,500.00	
No. 30, 15 @ 100.....	1,500.00	
	<hr/>	3,000.00

## NOTES:

Lowell Inst. for Savings, 6 mos.....	\$36,000	}	\$1,320.00
6 mos.....	30,000		
1 year.....	70,000		2,800.00
1 year.....	45,000		1,575.00
			<hr/>
			5,695.00

## COMMONWEALTH OF MASS:

1 year.....	\$75,000	\$3,000.00	
		<hr/>	3,000.00
			<hr/>
			\$51,095.00

## PRINCIPAL PAYMENTS:

Engine Loan.....	\$ 6,000	
Driven Wells Loan.....	10,000	
Driven Wells Loan.....	5,000	
Driven Wells Loan .....	5,000	
	<hr/>	26,000.00
		<hr/>
		\$77,095.00

TABLE VII.

## FINANCIAL STATEMENT—LOWELL WATER WORKS, 1896.

## DRIVEN WELLS ACCOUNT.

January 1, 1896. Balance.....			\$59,312.58
<b>EXPENDED :</b>	<b>CHELMSFORD.</b>	<b>BOULEVARD.</b>	
Pay rolls.....		\$ 3,630.25	
Paid Water Works for labor.....	\$ 742.00	303.50	
Telephone.....	15.60	37.11	
Supplies.....	.48	765.52	
Land .....	500.00		
Hydraulic Construction Co., balance contract.....	35,123.50	.	
B. F. Smith & Brother, on contract....		14,116.60	
	<hr/>	<hr/>	
	\$36,381.58	\$18,852.98	55,234.56
<b>Balance .....</b>			<hr/> \$4,078.02

## TABLE VIII.

## FINANCIAL STATEMENT—LOWELL WATER WORKS, 1896.

## MAINTENANCE AND CONSTRUCTION STATEMENT.

## MAINTENANCE.

## PAID FOR LABOR:

Office and Inspectors Salaries.....	\$10,677.27
Pumping Station No. 1.. ..	5,012.02
Pumping Station No. 2 and No. 3.....	6,549.46
Meter Repairs.....	1,738.21
General Maintenance.....	24,607.92
Reservoir.....	919.49

## PAID FOR MATERIAL:

Output as per stock books.....	2,596 09
Interest.....	51,095.00
General Expense.....	3,724 44
Stable.....	1,486.60
Reservoir.....	216.46
Morris Engine Repairs.....	1,129.01
Tools.....	572.68
Supplies: Pumping Station No. 1... ..	1,493.01
Pumping Station No. 2.....	630.73
Pumping Station No. 3.....	894.85
Coal: Pumping Station No. 1.. ..	3,062.57
Pumping Station No. 2.....	3,939.33
Pumping Station No. 3.....	3,792.06
Paid for Pumping Well Water....	16,102.46
	<hr/>
	\$140,239.60

## CONSTRUCTION.

## PAID FOR LABOR:

Extension, construction and new services.....	\$13,409.95
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## PAID FOR MATERIAL:

Output as per stock books.....	12,740.71
Principal payments.....	26,000.00
	<hr/>
	\$52,150.66

# SUPERINTENDENT'S REPORT.

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LOWELL, MASS., Jan. 1, 1897.

TO THE LOWELL WATER BOARD :

*Gentlemen:* It gives me great pleasure to present to you the annual report of the Superintendent of Water Works for the year ending December 31, 1896.

## SOURCE OF SUPPLY.

On February 22d last the 30-inch sluice gate on the river intake pipe controlling the direct feed from the Merrimack river, was closed and has not been opened since. This fortunate state of affairs was made possible by the completion of the Boulevard well plant.

The department has now at its service 380 wells, as follows: At No. 2 Station, off Plain street, 51 6-inch, 21 4-inch, 2 3-inch and 17 2-inch wells; at No. 3 Station, Chelmsford, 120 2-inch wells, and at No. 4 Station, Boulevard, 169 2½-inch wells.

## WELLS AT NO. 2 STATION.

It is now over three years (September, 1893,) since the wells located at what is now known as No. 2 Station were first pumped, and the yield today is, to say the least, as satisfactory both in quality and quantity as at first.

Owing to the large supply of water derived from the Boulevard wells, it was found that the constant running of one

plant could be dispensed with, and as Smith Bros., the contractors for the Boulevard plant, were required by their contract to run every day for a year, it became necessary to shut down one of the other plants; accordingly No. 2 Station, because of the greater expense of operating due to non-condensing pumps, extra lift, etc., was stopped from June 1 to December 1, except for a short run occasionally to turn over the machinery and make sure everything was in order in case of an emergency.

At this plant the suction pipes are laid on the surface, and, when not pumping, the ground water rises and flows into them. These conditions, together with the advent of severe cold weather, made it necessary to resume pumping in order to avoid freezing. This was done December 1, and the running of No. 3 Station discontinued. In 1895 two lines of suction pipe at No. 2 Station were lowered eight feet, and it was intended to complete the work of lowering the whole plant the past year, but the brook was too high and nothing was done. It is hoped, however, that before next winter this improvement may be accomplished. Three breaks in the suction line were repaired during the year by the use of sleeves and lead joints, as follows: 1 20-inch, 1 12-inch and 1 6-inch; these breaks were undoubtedly caused by the swelling of the ground after heavy rains and its alternate shrinkage in drying. Two men are now employed cleaning these wells, which is done by pumping and tripping every well individually. About one-half of them have been treated this way already with good results.

#### WELLS AT NO. 3 STATION.

The control of No. 3 Station, formerly owned and operated by the Hydraulic Construction Company of New York City, was assumed by the department April 24. Since then the

working of this plant has been almost constant until December 1, when it was stopped to allow the running of No. 2 Station. On December 26 it was started again for a few days in order to meet the extra consumption caused by a spell of severe cold weather. The pumps and suction at this station are placed eight feet below the surface so that there is no danger from freezing when not pumping.

The quality of the water from this plant is good with the exception of thirty wells on the A line, which were found to contain iron, and their use discontinued for the time being. In case of necessity, however, it would be far preferable to resume their use than to return to river water; in fact, the amount of iron contained in this water would not be perceptible when mixed with the rest of the supply. The water from these wells and also the wells at No. 2 Station would give much greater satisfaction if, instead of pumping the water into the distributing mains, it could be delivered directly into the reservoir or at some point beyond where the distribution begins. At present at No. 3 Station the water is first pumped through five thousand feet of 20-inch pipe to and connecting with the 30-inch pipe leading from the pumps at No. 2 Station. At this point the water from both plants coming together is forced through thirteen hundred feet of 30-inch pipe to Plain street where the 30-inch pipe branches off into 24 and 20-inch pipes, both of which further along lead into 16 and 12-inch mains, and finally through the smaller pipes of the system, all of which are inadequate for the free flowage of such a large volume of water as both of these plants can furnish when running together, the result being an increase of ten or twelve pounds back pressure on the pumps due to friction caused by forcing such a large amount of water through too small an area. Besides the injury to the pumping machinery ensuing from being overworked; in this manner and



the excessive use of coal caused thereby, probably the principal evil arising from these conditions occurs when one station is running and it becomes necessary to run them both. Then the pressure on the mains is so increased that the mud and sediment which has accumulated in the pipes is set in motion and all the water takers in that section of the city justifiably complain of the roily condition of the water. This same trouble frequently occurs in various parts of the city when the pressure becomes variable from excessive consumption. It sometimes happens, particularly in the central portion of the city, that the comparatively greater use of water in the daytime over the night causes a fluctuation in the flow of the water between the reservoir and the supply from the wells, thereby disturbing the sediment in the pipes, making the water unfit for domestic use.

Then there is the air that is forced into the mains from the wells ; if the water was discharged into the reservoir, the air would naturally escape instead of being confined in the pipes where it becomes foul, giving out a very disagreeable odor.

In view of the foregoing facts, it is hoped that your honorable board will take decisive steps looking to a remedy for these troubles as soon as possible.

#### BOULEVARD WELLS.

This plant being as yet in the hands of the contractors, it is sufficient to say that so far the quality of the water obtained is good and that the quantity has exceeded the expectations of everybody concerned ; also, that since these wells started they have furnished their share of the water needed and to all appearances are capable of furnishing still more if required.

Judging from all the facts and data obtainable, the department can without doubt depend upon a minimum supply of eight million gallons from the wells now in use at its command.

Since the 22d of February last all the water used and "wasted" has been taken from the three well plants save what water filtered through the ground into the filter gallery, and the surface water that found its way into the conduit by percolation. Previous to that date, in addition to the well water pumped, 80,857,600 gallons of water was drawn from the river, most of which passed through the filter inlet. The total pumpage of well water for the year was 2,346,925,894 gallons.

#### FILTER GALLERY.

The 24-inch delivery pipe from Boulevard wells was connected with the filter gallery February 1. This work required an excavation to a depth of fifteen feet and the removal of the west end of the gallery wall, where the pipe enters and projects about three feet into the gallery. This wall was afterwards rebuilt in a substantial manner. At the end of the gallery where the pipe enters, numerous springs were found yielding water of a quality not desirable as a supply in connection with the Boulevard well water. To overcome that difficulty and get rid of this imperfectly filtered water, a bed of concrete was laid one foot thick, beginning at the westerly end and tapering down to top of brace stone, a distance of one hundred feet. Where the 24-inch pipe discharges, a space covering ten feet was paved with Belgium blocks. Two centrifugal pumps, 6-inch and 4-inch, were run constantly twenty-four hours per day while this work was being done in order to keep the water down in the gallery.

Anticipating that the filter inlet would not be needed

much, if any, in the future, a sixteen-inch gate was set in the Inlet House on the 30-inch pipe connecting with the gallery. Since February 22 this gate has been opened but twice and then only to draw off the water on the filter bed when blowing out the conduit. An inspection of the gallery later in the month of October showed this gate to be tight, and also the end wall of the gallery and the concrete appeared to be in good condition, the latter being hard and well set. At this time the gallery walls were washed down and the bottom leveled and cleaned as well as possible.

#### BREAK IN THE CONDUIT, ETC.

Your honorable board are already familiar with the plan and general condition of the conduit and with the break in the conduit last March and the work of reconstructing the same; you became thoroughly posted as to its nature and extent by personal observation at the time, yet a description of the present condition of the conduit and tunnel embodying an account of the break, giving details, etc., will not be out of place.

On February 28 the water from the Boulevard wells was pumped through the conduit for the first time. On March 1 and 2 as the result of heavy rains the Merrimack River became swollen and overspread its banks, continuing to rise until 3 a.m., March 3, when it attained high water mark, 12 ft. 9 in. above Pawtucket dam. On Monday, March 2, at 4 o'clock a.m., the then recently completed easterly wall of the pump pit at the Boulevard Pumping Station caved in, flooding the engine room and thereby stopping the pumps from further service until the river receded. After this accident it was considered best, as a precaution in case of damage to the filter gallery by the freshet to close the gallery gate in the inlet

chamber, shutting off the water from the filter gallery and Boulevard wells. On March 3, the blow-off at the West Sixth Street Pumping Station was opened so as to drain the pump wells and the conduit for the purpose of cleaning them, when it was found that the amount being drained was more than the normal capacity of the conduit; the water was also colored and contained sand and clay, thus indicating one of two things, either that the gallery gates were leaking or that there was a break in the conduit line. An investigation was made at once, when it was discovered that between Gershom avenue and Riverside street, near New Moody street, at the location of an old blind shaft called Tunnel Shaft No. 1, that, where two days before there was a body of water (caused by recent rains) about half an acre in extent with a depth of several feet there was now a depression five feet deep, fifty feet long and thirty feet wide. This led to an immediate examination of the interior of the conduit and tunnel, revealing the fact that at a point where the tunnel was lined, just west of shaft No. 1, the perpendicular southerly side wall had fallen in for a distance of about sixty feet in the tunnel. The City Engineer's Report to the Water Commissioners January 1, 1873, describes this portion of the conduit as follows: "At the shafts and portions of the rock roof that were thought to be unsafe, brick-work was built eight inches thick; the side walls are perpendicular, four feet apart with a semi-circular arch. The space between the back of walls and sides of the tunnel was carefully filled with stone and grouted, and the space above the arch was filled with well rammed earth." Now the facts, as observed at the time of break, were that at that particular place the backing was carelessly filled, with no grouting, and as for the "space above the arch" that was found to be almost a void; furthermore, it was very evident that there would have been no break if the work was done as thoroughly as de-

scribed. The weather, when the break occurred, was extremely cold, and the consumption of water as a consequence was high, ranging about ten million gallons per day. The disabled condition of the conduit cut off the supply from the Boulevard wells, and the river, leaving the department to rely on No. 2 and No. 3 Stations, pumping 5,000,000 gallons per day, and the reserve in the reservoir for supplying the city. The amount of water in the reservoir available was about 15,000,000. In order to avoid a water famine, which these conditions made imminent, the water takers were, by notice in the public press, warned of the accident and requested not to waste the water. The police department were also called upon to assist in preventing waste and rendered valuable aid. But the chief thing was to place the conduit in condition for its work as soon as human effort could possibly do it. With that end in view, the work of excavating the shaft and cleaning out the debris that had fallen and washed into the conduit and obstructed the flow of water was begun immediately and prosecuted night and day.

The shaft was originally fifty-two feet long and twenty-five feet wide, the sides drawing in to a width of eight feet at the bottom, forty-two feet below the surface. As the break was west of the shaft, that end was excavated first. The timbering, which was very substantial, was done under the direction of F. W. Farnham of the City Engineer's office, and consisted of 8'' x 8'' spruce stretchers in frames every four feet, with 8'' x 6'' spruce for braces every eight feet, making eight foot bays; three-inch spruce was used for sheathing and lagging. A Carson excavating machine was hired from the Sewer Department, and put in position as soon as possible, proving advantageous in accelerating the work.

On March 11 the break was reached, and by the 12th all the obstruction to the flow of water was removed, and the

next day water from the Boulevard wells was allowed to flow through sufficiently to refill the reservoir.

Your honorable Board, after due consideration, having decided that instead of repairing the damaged part of the conduit it would be wiser to remove that entire section of brickwork in the shaft and contiguous on both sides, replacing the same by four foot cast iron pipe with a man-hole in the centre; accordingly the remainder of the shaft was excavated and timbered similar to the first section, and the old brick lining removed.

There being no great urgency, the greater part of this work was done in the daytime, while during the night sufficient water was allowed to pass through and not interfere with the day work.

Pending the arrival of the pipe, the silt which had been accumulating for years on the rough sides and floor of the tunnel, varying from 6 to 18 inches deep, was removed. The method adopted in doing this work was to wheel it to the shaft in wheelbarrows and then hoist it to the surface with the sewer machine. The fact of having the shaft open and located as it was, about midway in the tunnel with the advantage of having the sewer machine for hoisting, afforded unusual facilities for doing this very desirable piece of work speedily and economically. When the pipe arrived it was lowered in the cut on a large skid or run made of 8'' x 8'' spruce bolted firmly together and placed at an angle of thirty degrees with the surface; at the bottom the pipe was received on a truck specially designed for the purpose. It was at first thought that the pipe might be handled by the sewer machine, but as each pipe weighed about three and one-half tons, was twelve feet long and on account of the timbering would have to be lowered vertically, it was considered too hazardous. The machine, however, was very useful in assisting the handling

of the pipe by lifting it in place on the skids, holding a strain while descending, and loading on to the truck at the bottom of the cut, ready to wheel into line in the tunnel. The pipe was laid as near as possible to the old grade, made together with lead joints, and was 156 feet in length, including 48'' x 48'' x 48'' tee for manhole.

At each end of the pipe line brick bulkheads were constructed three feet thick from the bottom to the roof of the tunnel, also at the westerly entrance from the shaft another bulkhead of brick of the same thickness was built. Between these bulkheads, the space around the pipe and above it to the roof of the tunnel was thoroughly backfilled as was also the shaft. The manhole erected was of brick one foot thick, four feet in diameter at the bottom, three feet at the top and forty-five feet high with permanent iron steps, and cut stone cover similar to others used on the conduit. All the brickwork was laid in the best Portland cement, that used in the bottom being known as Alsen's Cement.

Two interior inspections have been made of this work since its completion, and everything was found to be in good condition.

#### SUPPLY CONDUIT — ITS GENERAL CONDITIONS, PLAN, ETC.

Engineer George E. Evans in his report to the Water Commissioners January 1, 1873, describes the supply conduit as follows: "In shape, a circle four feet three inches inside diameter and constructed of hydraulic brick masonry eight inches thick. The whole exterior of the conduit is covered with a coating of cement mortar to prevent the percolation of surface water into the conduit." An examination of that part of it extending from the inlet chamber through land formerly owned by Morse, Blood and Cummiskey, under the Mammoth

road and Third avenue, made during the past year, showed that under Third avenue the top was flattened for a distance of about 100 feet and otherwise in such a bad condition that it was liable to give trouble at any time ; also that the surface water did percolate through the brickwork notwithstanding that it was supposed to be impervious. Relative to this, it is well to bear in mind that this section of the city is now being rapidly built up, and the sewer arrangements are not of the best ; seventy-five houses have been erected within three hundred feet of the conduit during the last few years.

When the vacant land between the Mammoth road and Starbird street is lotted up the city should see to it that the strip fifty feet wide over the conduit, and now owned by the city, be laid out as a street, thereby making a continuous highway from the inlet chamber to the tunnel. Then if it becomes necessary to replace the brick conduit with cast iron pipe between those points it can be done at least more conveniently.

Regarding that part of the conduit from White street through the tunnel under New Moody street to the terminal chamber on Riverside street, owing to the erection of the new bridge across the river at Moody street, that locality is also being rapidly built upon, and however much it is to be regretted instead of owning a strip of land fifty feet wide over this part of the conduit, the city only has limited rights in a strip ten feet wide ; consequently, the houses are built very close to the line of the conduit, in fact, two buildings are already erected directly over it, and to make the matter more serious, there is no sewerage for this section, and for some time dry wells will have to be used.

The course of your honorable Board in calling upon the City Solicitor to protect the city's interests in the premises by securing an injunction restraining further building over the line of the conduit is both right and timely. Buildings should



not be erected so as to interfere with the proper maintenance of the conduit. Nothing should be left undone to preserve intact this excellent waterway with its great advantages of grade and line, and which cost the city so much to build.

A careful inspection of the interior shows fewer leaks than in the part between the inlet chamber and the tunnel, and the leaks found are confined to what is known as the sand tunnel, which is 375 feet long and is built of the regular section four feet, three inches inside diameter. The brick masonry in the rock tunnel is in good condition, except at one point, where a section of the perpendicular wall bulges in slightly, caused by water probably finding its way through seams in the rock to the back of the brickwork, and exerting a pressure thereon.

The importance of a system of sewerage for that section, to be built as soon as possible, cannot be too strongly urged, if the water in its passage through the conduit is to be preserved from contamination. Furthermore, all sewerage pipes laid for this section should be exclusively of iron with lead joints.

The following is a fair estimate of leakage into the gallery and conduit, pumping 4,000,000 gallons at West Sixth Street Station and 3,500,000 gallons at the Boulevard Station :

Eighty-three and one-third per cent. of total pumpage West Sixth Street Station obtained from wells.

Fourteen and one-third per cent. of total pumpage West Sixth Street Station obtained from filter gallery.

Two and one-third per cent. of total pumpage West Sixth Street Station from leaks in conduit.

#### PUMPING STATIONS AND PUMPING MACHINERY.

At Pumping Station No. 1, West Sixth street, the Morris Engine, which after being rebuilt by the Wheelock Engine

Company of Worcester in 1895 and run 203 days, continued to do the pumping last year in a satisfactory manner until February 21, when, while running as usual, the jacket-head of the low pressure steam cylinder exploded, throwing parts of it in various directions about the engine room, one piece striking Engineer Quinn, but fortunately not inflicting serious injury.

The different parts collected together upon examination showed beyond a doubt that the explosion was due to a defective casting. A new head of extra strength was made by the Wheelock Engine Company, and the engine was started again on March 27, when after running apparently as well as ever for about fifteen minutes the crank pin snapped off. Again the services of the Wheelock Engine Company were called into use, and the engine thoroughly overhauled. No cause was discovered for the accident to the crank pin unless it could be attributed to a blow received as the effect of the bursting of the cylinder head before mentioned. But whatever the cause, the result was found to be quite damaging to the working parts of the engine. The base of the high and low pressure cylinders were found to be cracked beyond repair. The two piston rods were badly bent, the stem of the throttle valve broken off, the straps, keys and gibs of the parallel motion strained out of shape and the piping, etc., also damaged. The task of restoring the engine to its former condition having been referred by your honorable board to a committee consisting of the President and Superintendent was undertaken without delay; a new crank pin was forged by the Nashua Forging Company of Nashua, new keys and gibs were made by the American Bolt Co., and the castings and other parts were furnished by the American Wheelock Engine Co. The piston rods were also sent to them for straightening. All of the heavy work, taking the machinery apart so as to re-

move the damaged parts, putting it together again and getting the broken pin out of the crank arm was done by the department help. Considerable of the mechanical work such as turning and fitting the new crank pin, finishing and fitting the new keys, gibs, etc., was done in the department shop under the supervision of Mr. McClure of the American Wheelock Engine Co. After completing the repairs the engine was started once more August 22 and run for three days.

Following the accident to the Morris engine, the Low Duty Worthington Pump was run for a short time, but owing to the superior economy of the High Duty Worthington, it was used to do most of the pumping for the year; which although run at only about one-half speed did its work very efficiently.

The old flanged steam line which was originally put in for the Morris engine over 25 years ago, and later used for the Low Duty Worthington Pump, leaked so badly that, acting upon your instructions, it was replaced by a new pipe with thread joints. An additional valve was set in the high duty steam line so that now any one of the three pumps can be operated by either set of boilers. Upon the recommendation of the Inspector of the Hartford Boiler Insurance and Inspection Co., a kerosene oil feeder was attached to the feed pipe of the boilers. Under the efficient management of Engineer Bartlett everything about the station is now in good order.

At Pumping Station No. 2, off Plain street, thanks to the capable and careful handling of Engineer Thomas McLaughlin everything there is in as good trim as possible. A new follower for the piston head on No. 1 pump was the only repairs necessary on any of the boilers or pumps during the year.

For the purpose of weighing coal for this Station and No. 3 Station a new Howe Platform Scales, 20 ft. long by 8 ft.

wide of 12,000 lbs. capacity was placed on the north side of the building. The excavation and brick foundation work for the same being done by the regular Water Works men.

Pumping Station No. 3, which was built by the Hydraulic Construction Co., has undergone considerable improvement since coming into possession of the city. In the first place the boiler room was enlarged 10 ft. wide by 30 ft. long, giving much needed room for handling coal, besides increasing the stability of the building, which at best is none too strong to withstand the storms and wind to which it is at times exposed in that locality. The boiler room floor was paved with brick and the floor of the pump pit was also improved by the application of about two inches more of concrete, making it drier and more comfortable to walk upon. New stairs were built from the pump pit to the office floor, and the interior of the office furnished and painted. Another important improvement was the providing of increased storage for coal. Last winter when the Hydraulic Co. were using over 150 tons of coal per month, not having place to store only 200 tons they were obliged several times to have more hauled, which, owing to the well nigh impassible condition of the roads in that section from snow drifts, etc., cost them a dollar a ton extra. Profiting by their experience in this matter, and having several thousand feet of lumber left over from the conduit break in stock, it was thought best to demolish the small bin built by the Hydraulic Construction Co., and replace it by one large enough to store sufficient coal to last through the winter. Accordingly, a new coal bin capable of holding 1,000 tons was erected. Part of the lumber before mentioned was used in its construction and proved admirably suited for the purpose, the 4-foot pieces of 3'' plank being utilized for the flooring, the long 3'' plank for the sides and the 8'' x 8'' x 6'' timbers came in well for the floor beams and posts. The sides are well sup-

ported, partly by an earth embankment and partly by 3'' plank braces notched into the floor timbers and upright posts. The whole structure is substantially built and ought to last for years.

The roads approaching the Station have been widened, graded and otherwise improved during the year. Considerable grading and filling was done in the rear of the Station, and a large well made of 3'' plank with a concrete bottom was built, into which all the water from the drip pipes, waste pipes and blow-off pipes is collected and thence conducted through a 12'' earthen pipe beyond the main pipes to a ditch leading into the main channel of the brook.

A new 6'' x 4'' x 6'' Worthington boiler feed pump was set in the boiler room taking the place of one too small for the work.

Last September in the water ends of No. 1 pump a crack was discovered, extending vertically from top to bottom between the cylinders, permitting leakage from one chamber to the other, and destroying somewhat the efficiency of the pump. It was repaired by bolting pieces of angle iron on each side and rusting together making a tight joint.

A Locke damper was also purchased for and set up at this Station, effecting a material saving in coal.

#### RESERVOIR.

As anticipated, during the summer the action of light and heat on the water in the open reservoir developed a growth known as Alga, which gave to the water a very obnoxious odor and taste. This same trouble occurs wherever the ground water is pumped into an open reservoir, and the usual remedy is to build a new covered reservoir or to cover the old one when practicable. But this department was fortu-

nate in being able to overcome this difficulty in a much less expensive way, which was simply done by opening a gate between the influx and efflux chambers at the gate house, and thereby allowing the water to flow into the distributing main as pumped without going into the reservoir. After that was done very little complaint was heard regarding the odor or taste of the water. In fact, changing the course of the water at the reservoir gate house, preventing as it did the circulation of fresh water through the reservoir had the effect of checking the growth of Alga to some extent.

During the months of July and August the amount of water in the reservoir was gradually lowered until August 14, when it reached 12 ft. 4 in., the lowest it had been since it was rebuilt in 1885. The object of thus lowering the reservoir was partly to notice what effect it might have on the growth of Alga, and also to observe the condition of the paving on the slopes and the stone masonry of the gate house. Three kinds of Algæ were found, and samples taken and placed in bottles at the City Engineer's office.

As to the condition of the paving of the slopes, that relaid in 1885 was as good as when laid, but the old paving didn't look so well; quite a large space exists between some of the courses, and in one place a marked depression can be seen in the face of the slope by sighting. Still there didn't seem to be any liability of it sliding in.

The stone masonry supporting the gate house is not in good condition, a number of the stones have fallen out and the water leaks through the walls. Next summer these walls should be replaced and repointed.

Professor Sedgewick of the Institute of Technology and State Biologist visited the reservoir at the time of the trouble about Algæ, and he expressed himself as satisfied that nothing was growing there that would affect the purity of the water.

He also took occasion to speak very complimentary of the condition of the reservoir and grounds, comparing them favorably with any he had ever seen.

The fence around the reservoir received two coats of paint during the year, the gate house also received a much needed painting. The keeper's house coming in for its share of attention, several rooms being papered, painted and white-washed, and the roof shingled.

#### HIGH SERVICE RESERVOIR.

The fence around this reservoir was also painted, and, judging from the facility with which the wood absorbed the paint, it was some years since it was painted before.

Several of the large stones which compose the bank wall around the reservoir lot were out of line, probably caused by the heaving of the earth. They were moved back into position and the fence which rested on them straightened.

#### DISTRIBUTION.

During the year 19,420 feet of main pipe was laid on the high and low service, of this 1205 feet was replacing smaller pipe on Merrimack, Moody, Pawtucket and Gates streets. The total number of feet of main pipe laid to January 1, 1897, is 623,431.8 ft. or 118 7-10 miles.

The most important piece of pipe laying during the year was the continuation of the 12-inch main on Merrimack street to and through Pawtucket street to Moody street, thence across the new Moody street bridge to Colonial avenue.

#### GATES.

To control the 12-inch pipe on Moody street bridge, 2 12-inch gates were set, one on Moody street to Pawtucket street

and another on Moody street to Colonial avenue. Fifty-three gates were set during the year.

#### HYDRANTS.

In addition to the 2 8-inch hydrants set on Jackson street last year at the request of the Hamilton Co., two more 8-inch hydrants were set this year on Middlesex street, convenient to be used in case of fire in their large storehouse. In all 36 additional hydrants were set during the year, 10 flush hydrants were replaced by post hydrants, 50 hydrants were repaired and 32 flush hydrant boxes were renewed.

#### FIRE SERVICES.

Fire services were laid during the year as follows :

Otis Allen & Son, for mill, Willie street, 6-inch pipe.  
 White Bros., for mill, Perry street, 6-inch pipe.  
 Haworth & Watson, for mill, Tanner street, 6-inch pipe.  
 P. J. Riley & Co., storehouse, Tanner street, 6-inch pipe.  
 F. G. Mitchell & Co. (Bon Marche store), Merrimack st., 6-inch pipe.  
 James A. Thompson, for hydrants, Congress street, 4-inch pipe.

#### SERVICES.

During the year 332 new services were laid and 212 old services changed for lead or larger iron pipe.

A special effort was made during the year to cut off at the main all discontinued services not likely to be used again. As a result 106 were cut off, some of them not having been used for years.

#### NEW SERVICES.

125 5-8-inch Lead Pipe . . . . .	4,266 feet
196 3-4-inch Lead Pipe . . . . .	7,110 "
6 1-inch Lead Pipe . . . . .	129 "
2 3-4-inch Iron Lead Lined Iron Pipe .	179 "



1 1-inch Iron Lead Lined Iron Pipe . . . . .	150 feet.
2 2-inch Iron Lead Lined Iron Pipe . . . . .	93 "
1 1 1-2-inch Iron Pipe . . . . .	164 "
<hr/>	
333 Total laid in 1896 . . . . .	12,091 "
Amount previously laid . . . . .	374,811 "
Total now laid . . . . .	386,902 "
Total services laid . . . . .	10,544 "
Total cut off at main . . . . .	675 "
Total reconnected . . . . .	44 "
Total now in use . . . . .	9,913 "

SERVICES CHANGED.

No.	Kind.	CHANGED TO							
		Lead 5/8-in.	Lead 3/4-in.	Lead 1-in.	Lead Iron	Lined Pipe 3/4-in.	Iron 4-in.	Iron 1-in.	Total ft.
59	3/4-in. iron.....	1,864	....	....	....	....	....	....	1,864
128	3/4-in. iron.....	....	3,649	....	....	....	....	....	3,649
16	3/4-in. iron.....	....	....	523	....	....	....	....	523
3	1-in. iron.....	....	69	....	....	....	..	....	69
1	1 1/2-in. iron....	....	....	19	....	....	....	....	19
1	1-in. iron.....	....	....	27	....	....	....	....	27
1	5/8-in. lead.....	....	22	....	....	....	....	....	22
1	3/4-in. iron.. . .	....	....	....	....	89	....	....	89
1	1 1/2-in. iron.....	....	....	....	....	....	87	....	87
1	3/4-in. iron.....	....	....	...	....	....	....	94	94
212	Total.	1,864	3,740	569	....	89	87	94	6,443

METERS.

There were 622 meters set the past year against 350 the previous year, an increase of 272. It might be interesting to note in this connection that the revenue of the department also shows a comparatively large increase over the previous

year, while the difference in consumption of water between the last two years is very much less than usual. Number of meters worn out and condemned, 64, of this number 60 were replaced with new meters, 37 meters were discontinued of these some belong to contractors and are only temporarily out of use. Thirty-eight meters were frozen and burst, a large proportion of which were repaired and set again. The total number of meters repaired is 615.

## METERS RUNNING JANUARY 1, 1897.

Size.	$\frac{5}{8}$ -in.	$\frac{3}{4}$ -in.	1-in.	$1\frac{1}{2}$ -in.	2-in.	3-in.	4-in.	6-in.	Total.
Desper.....	101	41	10	....	....	....	....	....	152
Crown.....	1,378	1,323	249	8	12	2	5	2	2,979
Worthington.	237	27	52	67	32	8	3	....	426
Duplex.....	7	12	7	....	....	....	....	....	26
Ball & Fitts..	2	....	....	....	....	....	....	....	2
Fitts Rotary..	1	1	....	....	....	....	....	....	2
Frost.. .....	10	6	2	....	....	....	....	....	18
Thomson .....	8	19	3	....	....	....	....	....	30
Gem.....	....	....	....	....	5	....	2	1	8
Metropolitan.	....	2	....	....	....	....	....	....	2
Trident.....	25	8	1	....	....	....	....	....	34
Nash.....	5	13	....	....	....	....	....	....	18
Lambert.....	3	4	....	....	....	....	....	....	7
Niagara.....	....	1	....	....	....	....	....	....	1
Hersey.....	21	26	3	....	....	....	....	....	50
Empire.....	....	3	....	....	....	....	....	....	3
Westingh'se..	....	1	....	....	....	....	....	....	1
Total.	1,798	1,487	327	75	49	10	10	3	3,759

## PRIVATE METERS RUNNING JANUARY 1, 1896.

Size .....	$\frac{3}{8}$ -in.	$\frac{5}{8}$ -in.	$\frac{3}{4}$ -in.	1-in.	2-in.	Total.
Desper .....	....	1	3	1	....	5
Worthington .....	....	....	....	1	2	3
Crown .....	1	24	20	1	....	46
Duplex .....	....	1	....	....	....	1
Thomson .....	....	....	1	....	....	1
Hersey.....	....	1	....	....	....	1
Nash.....	....	4	1	....	....	5
Frost.....	....	2	1	....	....	3
Total.....	1	33	26	3	2	65

## MISCELLANEOUS.

The blow-off pipes on the street mains were opened up five different times during the year. About two million gallons of water were used every time, and a great deal of rust, sediment, etc., carried off with the water, thereby cleaning the pipes and improving the water throughout the city.

Hydrants on "dead ends" were also "blown off" when occasion required for the purpose of clearing and improving the water.

The drinking fountain at the junction of Lakeview avenue and Aiken street was moved from the westerly side of Aiken street to the centre of the square, and the large combination fountain at the corner of Merrimack and Bridge streets was taken out and replaced by a small fountain for people similar to the one at Monument square.

About the usual number of leaks were reported during the year, all but three of them in service pipes; those three were small leaks in lead joints, none of them being of any importance.

## CONCLUSION.

In concluding this report it gives me great pleasure to express to President Putnam and the members of the Water Board my heartfelt gratitude for the confidence you have imposed in me during the year, and for your cordial support at all times, and to the clerk of the Board, John W. Crawford, I also cheerfully acknowledge myself indebted for kind co-operation in the work of the department.

Respectfully submitted,

ROBERT J. THOMAS,

*Superintendent.*

## LOW SERVICE. — WATER PIPES LAID IN 1896.

STREETS.	BETWEEN WHAT STREETS	Length in feet							Total
		4-in.	6-in.	8-in.	10-in.	12-in.	16-in.	24-in.	
Adams Ct.	Southerly from Church.		123						123 0
Albert	Westerly to Stevens.		286						286 0
Andrews	Extended southerly		121						121 0
Ardell	Easterly from Ina.		138						138 0
Avon	North'y and south'y from 6th Ave		712						712 0
Beacon	Extended southerly		100						100 0
Belle Ave	Westerly from Stevens.		148						148 0
Bellevue	Southerly to Thayer			54					54 0
Billings	Easterly from Barker Ave.		148						148 0
Blossom	Extended westerly		67						67 0
Bourne	Extended northerly		162						162 0
Broadway	Extended westerly		68						68 0
Burgess	Easterly from Hastings.		221						221 0
Burlington Ave	Extended southerly		48						48 0
Burnside	Fulton and Stanley.	240							240 0
Burt	Westford and Pine		828						828 0
C	Westerly from Puffer		144						144 0
Canada	Easterly from Tanners.		26						26 0
Carlton	Northerly to Middlesex.		55						55 0
Charles Ave	Extended easterly		48						48 0
Crawford.	Southerly from 5th Ave.		129						129 0
Crescent.	Northerly from Blodgett		180						180 0
Crowley	Extended southerly.		54						54 0
Dartmouth	Extended northerly			72					72 0
Ellsworth	Westerly from Gorham		286						286 0
Fernald	Southerly from Westford.		276						276 0
Fifth Ave	Easterly from Avon		215						215 0
Fort Hill Ave	Southerly from Sherman		325						325 0
Fort Hill Ave	Northerly to Oak		172						172 0
French	Mt. Vernon and Willie			486					486 0
Total		240	4119	611					5061 0

LOW SERVICE.—WATER PIPES LAID IN 1896.—*Continued.*

STREETS.	BETWEEN WHAT STREETS.	Length in feet.							Total.
		4-in.	6-in.	8-in.	10-in.	12-in.	16-in.	20-in.	
	<i>Brought forward</i> .....	240	4110	611	1153				5961.0
Gardner Ave...	Westerly from Moody.....		231						231 0
Gates.....	Southerly from Sheldon.....		100						100.0
Gates.....	Southerly from Westford (relaid)..		615						615.0
Holmes Ave...	Easterly from Mammoth Road.....		220						220.0
Houghton .....	Extended northerly.....		52						52 0
Ina .....	Northerly from Third Ave.....		158						158.0
Lawrence .....	Southerly to town line.....		518						518.0
Leverett .....	Extended southerly.....	65							65.0
Lexington Ave.	Southerly from Varnum Ave... ..		414						414 0
Ludlam .....	Extended easterly.....		144						144 0
Maple.....	Westerly towards West.....		200						200.0
Merrimack ....	Northerly to Pawtucket (relaid)...					54			54.0
Merrimack.....	Fire service F. G. Mitchell.....		28						28.0
Middlesex Park	Extended northerly.....		260						260.0
Moody.....	Pawtucket and Colonial Ave.....					741			741.0
Moody.....	Riverside and Fourth Ave.....				1153				1153.0
Mt. Hope.....	Fourth and Fifth Ave.....		356						356.0
Nelson .....	Southerly from Middlesex.....		237						237.0
New Ave.....	Southerly from Ludlam.....	133							133.0
Oak Ave.....	Southerly from Arch.....		89						89.0
Oakland ... ..	Extended southerly.....		48						48.0
Orleans.....	Northerly and easterly from Fred.		627						627.0
Pawtucket.....	Moody and Merrimack (relaid)....					229			229.0
Perrin.....	Extended westerly.....		356						356.0
Perry.....	Extended southerly.....			197					197.0
Perry .....	Fire service White Bros.....		17						17.0
Phoebe Ave....	Easterly from Sarah Ave.....		174						174 0
Poplar .....	Westerly from School.....		394						394.0
Reed Ave.....	Westerly from Orleans.....		120						120.0
Sanders Ave...	Southerly from Pine.....		644						644.0
Sarah Ave.....	Northerly from Riverside.....		183						183.0
	<i>Carried forward</i> .....	438	11,295	808	1153	1024			14,718 0

## LOW SERVICE.—WATER PIPES LAID IN 1896.



STREETS.	BETWEEN WHAT STREETS	Length in feet.							Total.
		4-in.	6-in.	8-in.	10-in.	12-in.	16 in.	20-in.	
Adams Ct.....	Southerly from Church.....		123						123 0
Albert .....	Westerly to Stevens.....		286						286.0
Andrews ... ..	Extended southerly.....		121						121.0
Ardell.....	Easterly from Ina.....		138						138.0
Avon .....	North'y and south'y from 6th Ave		712						712 0
Beacon ... ..	Extended southerly.....		100						100.0
Belle Ave.....	Westerly from Stevens.....		148						148.0
Bellevue... ..	Southerly to Thayer.....			54					54.0
Billings.....	Easterly from Barker Ave. ....		148						148 0
Blossom .....	Extended westerly.....		67						67.0
Bourne ... ..	Extended northerly.....		162						162.0
Broadway.....	Extended westerly.....		68						68.0
Burgess.....	Easterly from Hastings.....		221						221.0
Burlington Ave	Extended southerly.....		48						48.0
Burnside .....	Fulton and Stanley.....	240							240 0
Burt .....	Westford and Pine.....		828						828.0
C .....	Westerly from Puffer.....		144						144.0
Canada .....	Easterly from Tanners.....		26						26.0
Carlton.....	Northerly to Middlesex... ..		55						55.0
Charles Ave....	Extended easterly.....		48						48.0
Crawford.....	Southerly from 5th Ave.....		129						129.0
Crescent.....	Northerly from Blodgett.....		180						180.0
Crowley .....	Extended southerly.....		54						54.0
Dartmouth ....	Extended northerly.....			72					72.0
Ellsworth .....	Westerly from Gorham.....		286						286.0
Fernald .....	Southerly from Westford.....		276						276 0
Fifth Ave.....	Easterly from Avon.....		215						215 0
Fort Hill Ave..	Southerly from Sherman.....		355						355.0
Fort Hill Ave..	Northerly to Oak.....		172						172.0
Fulton .....	Mt. Vernon and Willie.....			485					485.0
	<i>Carried forward.....</i>	240	4110	611					5961.0

LOW SERVICE.—WATER PIPES LAID IN 1896.—*Continued.*

STREETS.	BETWEEN WHAT STREETS.	Length in feet.							Total.
		4-in.	6-in.	8-in.	10-in.	12-in.	16-in.	20-in.	
	<i>Brought forward</i> .....	240	4110	611	1153				5961.0
Gardner Ave...	Westerly from Moody.....		231						231 0
Gates.....	Southerly from Sheldon.....		100						100.0
Gates.....	Southerly from Westford (relaid)..		615						615.0
Holmes Ave....	Easterly from Mammoth Road....		220						220.0
Houghton .....	Extended northerly.....		52						52 0
Ina .....	Northerly from Third Ave.....		158						158.0
Lawrence .....	Southerly to town line.....		518						518.0
Leverett .....	Extended southerly.....	65							65.0
Lexington Ave.	Southerly from Varnum Ave... ..		414						414 0
Ludlam .....	Extended easterly.....		144						144 0
Maple.....	Westerly towards West.....		200						200.0
Merrimack ....	Northerly to Pawtucket (relaid)...					54			54.0
Merrimack.....	Fire service F. G. Mitchell.....		28						28.0
Middlesex Park	Extended northerly.....		260						260.0
Moody.....	Pawtucket and Colonial Ave.....					741			741.0
Moody.....	Riverside and Fourth Ave.....				1153				1153.0
Mt. Hope.....	Fourth and Fifth Ave.....		356						356.0
Nelson .....	Southerly from Middlesex.....		237						237.0
New Ave.....	Southerly from Ludlam.....	133							133.0
Oak Ave.....	Southerly from Arch.....		89						89.0
Oakland ... ..	Extended southerly.....		48						48.0
Orleans.....	Northerly and easterly from Fred.		627						627.0
Pawtucket.....	Moody and Merrimack (relaid)....					229			229.0
Perrin.....	Extended westerly.....		356						356.0
Perry.....	Extended southerly.....			197					197.0
Perry .....	Fire service White Bros.....		17						17.0
Phœbe Ave....	Easterly from Sarah Ave.....		174						174 0
Poplar .....	Westerly from School.....		394						394.0
Reed Ave.....	Westerly from Orleans.....		120						120.0
Sanders Ave....	Southerly from Pine.....		644						644.0
Sarah Ave.....	Northerly from Riverside.....		183						183.0
	<i>Carried forward</i> .....	438	11,295	808	1153	1024			14,718 0



**LOW SERVICE. — LIST OF STOP GATES SET DURING THE  
YEAR 1896.**

STREETS.	LOCATION.	4-in.	6-in.	8-in.	10-in.	12-in.
Adams Cl.	1 ft. south of  Street, 10½ ft. east of west line	1				
Albert .. ..	12 ft. north of south line Albert, on east line Stevenson Street	1				
Avon .. .	12 ft. north of south line Avon Street, on east line Fifth Ave	1				
Barclay . . .	14 ft. east of west side Barclay, on north line Liberty Street	1				
Belle Ave. . . . .	12 ft. north of south line Belle Ave., on west line	1				
Burgess....	north line Burgess, on east line	1				
Burt	line Burt Street, on south line of	1				
Burt .....	13 ft. east of west line Burt Street, 1½ ft. south of north line Pine Street	1				
Burnside . . . . .	6 ft. north of south line Burnside Street, on east line Stanley Street	1				
Cabot . . . . .	 1 ft. south of west line	1				
Canada .. .	13 ft. north of south line Canada Street, on east line Tanners Street	1				
Carlton . . . . .	e Carlton Street, on south	1				
Crawford	line Crawford Street, on east	1				
Ellsworth . . . . .	12 ft. the Street, and on	1				
Fernald . . . . .	10 Street, and on the	1				
Fort Hill Ave . .	line Fort Hill Ave., on south line	1				
Fort Hill Ave	12 ft. west of east line Fort Hill Ave., on south line Oak Street	1				
Fulton . . . . .	23 ft. south of north line Fulton Street, on east line Mt. Vernon Street		1			
Fulton ..	10½ ft. north of south line Fulton Street, on west line Willie Street		1			
Gardner Ave	11 ft. north of south line Gardner Ave., on west line Moody Street	1				
Gates ...	Westford Street Street, on south line	1				
Holmes	12 ft. south of north line Holmes Ave., on east line	1				
Ina ...	12 ft. west of east line Ina Street, on north line Third Ave	1				

**LOW SERVICE.—LIST OF STOP GATES SET DURING THE YEAR, 1896.—Continued**

LOW SERVICE.—LIST OF STOP GATES SET DURING THE YEAR 1896.—*Continued.*

**LOW SERVICE.—LIST OF HYDRANTS SET DURING THE  
YEAR 1896.**

STREETS.	LOCATION.
Avon .....	Southerly side, 2 ft. east of Sixth Avenue.
Avon .....	Southerly side, 6 ft. east of Fifth Avenue.
Belle Ave.....	Southerly side, 136 feet west of Stevens Street.
Beech....	Easterly side, on terminus.
Bourne .....	Westerly side, between Moore and Otis Streets.
Blossom .....	Northerly side, on terminus.
Broadway.....	Northerly side, on terminus.
Burgess .....	Northerly side, 209 ft. east of Hastings Street.
Burt.....	Westerly side, 300 ft. south of Westford Street.
Congress.....	In mill yard of Walter Coburn.
Crawford.....	Southerly side, 4½ ft. east of Fifth Avenue.
Edwards.....	Easterly side, on pipe terminus.
Ellsworth .....	Southerly side, 270 ft. west from Gorham Street.
Fort Hill Ave .....	Easterly side, 85 feet south of Aster Street.
Fulton .....	Southerly side, 188 feet west of Willie Street.
Gates.....	Easterly side, 124 ft. south of Westford Street.
Hadley .....	Easterly side, on pipe terminus.
Harvard .....	Easterly side, 305 feet south of Middlesex Street.
Lawrence .....	Easterly side, 5 ft. north of town line.
Lexington Ave.....	Easterly side, 377 ft. south of Varnum Avenue.
Maple .....	Southerly side, near West Street.
Middlesex.....	Southerly side, 23 ft. east of Elliott Street.
Middlesex.....	Southerly side, 3½ ft. west of Marston Street.
Mt. Hope.....	Westerly side, 68 ft. north of Fourth Avenue.
Moody.....	Westerly side, 27 feet south of Fourth Avenue.
Orleans .....	Southerly side, opposite Reed Avenue.
Perrin.....	Northerly side, on pipe terminus.
Perry.....	Easterly side, opposite White Bros.' new mill.
Poplar .....	Northerly side, 350 ft. west from School Street.
Prescott.....	Easterly side, changed and replaced old flush.
Riverside.....	Southerly side, 36 ft. east of Terminal Chamber.
Sanders Ave.....	Westerly side, 53 ft. south of a new street.
Sidney.....	Westerly side, 308 ft. south of Moore Street.
Stevens.....	Westerly side, 130 ft. south of Albert Street.

## LOW SERVICE.—LIST OF STOP GATES SET DURING THE YEAR 1896.—Continued.

STREETS.	
Tanners . . .	
Tanners . . . . .	
Thorndike . . .	
Warwick	12 ft. west of east side Warwick Street, on north of Shaw. . . . .
Waterville	12 ft. south of north line Waterville, on east line Windward Ave. . . . .
Willis . . . . .	67½ ft. north of north line Rock Street, on line service to Allen's Mill . . . . .

**LOW SERVICE.—LIST OF HYDRANTS SET DURING THE  
YEAR 1896.**

STREETS.	LOCATION.
Avon .....	Southerly side, 2 ft. east of Sixth Avenue.
Avon .....	Southerly side, 6 ft. east of Fifth Avenue.
Belle Ave. ....	Southerly side, 136 feet west of Stevens Street.
Beech. ....	Easterly side, on terminus.
Bourne .....	Westerly side, between Moore and Otis Streets.
Blossom .....	Northerly side, on terminus.
Broadway. ....	Northerly side, on terminus.
Burgess .....	Northerly side, 209 ft. east of Hastings Street.
Burt. ....	Westerly side, 300 ft. south of Westford Street.
Congress. ....	In mill yard of Walter Coburn.
Crawford. ....	Southerly side, 4½ ft. east of Fifth Avenue.
Edwards. ....	Easterly side, on pipe terminus.
Ellsworth .....	Southerly side, 270 ft. west from Gorham Street.
Fort Hill Ave. ....	Easterly side, 85 feet south of Aster Street.
Fulton .....	Southerly side, 188 feet west of Willie Street.
Gates. ....	Easterly side, 124 ft. south of Westford Street.
Hadley .....	Easterly side, on pipe terminus.
Harvard .....	Easterly side, 305 feet south of Middlesex Street.
Lawrence .....	Easterly side, 5 ft. north of town line.
Lexington Ave. ....	Easterly side, 377 ft. south of Varnum Avenue.
Maple .....	Southerly side, near West Street.
Middlesex. ....	Southerly side, 23 ft. east of Elliott Street.
Middlesex. ....	Southerly side, 3½ ft. west of Marston Street.
Mt. Hope. ....	Westerly side, 68 ft. north of Fourth Avenue.
Moody. ....	Westerly side, 27 feet south of Fourth Avenue.
Orleans .....	Southerly side, opposite Reed Avenue.
Perrin. ....	Northerly side, on pipe terminus.
Perry. ....	Easterly side, opposite White Bros.' new mill.
Poplar .....	Northerly side, 350 ft. west from School Street.
Prescott. ....	Easterly side, changed and replaced old flush.
Riverside. ....	Southerly side, 36 ft. east of Terminal Chamber.
Sanders Ave. ....	Westerly side, 53 ft. south of a new street.
Sidney. ....	Westerly side, 308 ft. south of Moore Street.
Stevens. ....	Westerly side, 130 ft. south of Albert Street.

### HIGH SERVICE — LIST OF STOP GATES SET DURING THE YEAR 1896.

STREETS.	LOCATION	4-in.	6-in.	8-in.	10-in.	12-in.	16-in.	20-in.
Hazel.	14 ft. north of south line Hazel, on east line of Rogers Street..	..	1	..	..	..	..	..
Third. ...	13 ft. south of north line Third Street, on east line Beacon Street.....	..	1	..	..	..	..	..

### HIGH SERVICE — LIST OF HYDRANTS SET DURING THE YEAR 1896.

STREETS.	LOCATION.
Beacon	Westerly side, on High Service pipe terminus.
Third	Northerly side, 307 ft. east of Beacon Street.

### STOCK ON HAND JAN. 1, 1897.

	4-in.	6-in.	8-in.	10-in.	12-in.	16-in.	20-in.	24-in.	30-in.
Lengths of Pipe	.	86	478	577	296	40	23	51	25
Fleeces	..	9	12	5	14	8	1	5	9
Caps	70	30	47	..	12	3	..	2	..
Plugs	10	10	6	3	..	..	..	..	..
Curves, $\frac{1}{4}$ ...	4	5	10	2	9	..	..	..	..
Curves, $\frac{1}{2}$ ...	..	7	1	2	..	1	4	5	..
Curves, 1-16	..	..	10	..	..	3	6	1	3

2 lengths 24-inch flange pipe; 9 lengths 8-inch flange pipe. Flange Specials. — 8x6x4 threeways, 5; 10x8x4 threeways, 8; 8x8x4 threeway, 1; 12x12x20 threeway, 1; 6x6x4 threeway, 1; 20x20x12 threeways, 5; 16x12x12 threeway, 1; 20x16x12 threeway, 1; 8x6x6x4 fourway, 1; 2 4-inch,  $\frac{1}{4}$  turns; 1 8-inch,  $\frac{1}{4}$  turn; 2 8-inch,  $\frac{1}{4}$  turns.

**CAST IRON PIPE** (short pieces.)—30-inch, 10 ft.; 24 inch, 40 ft.; 20 inch, 54 ft.; 16 inch, 88 ft.; 12 inch 6 ft.; 10 inch, 15 ft., 8 inch, 40 ft.; 6 inch 36 ft.; 4 inch, 40 ft. One 30-inch manhole, 1 30-inch clamp sleeve, 1 24-inch clamp sleeve, 3 6-inch offsets, 3 6-inch Smith gates, 3 8x6 Smith sleeves, 1 6x2 Smith sleeve, 4470 lbs. pig lead, 253 lbs. yarn. **HYDRANTS**.—Ludlow, 8; Chapman, 1; Michigan, 2; Lowry, 1; 1 Top for Chapman Hydrant; 2 barrels for Chapman Hydrant. **GATES**.—4-inch, 7; 6-inch, 4; 8-inch, 10; 10-inch, 4; 12-inch, 3; 555 lbs.  $\frac{5}{8}$ -inch lead pipe, 817 lbs. 1-inch lead pipe, 488 lbs.  $\frac{3}{4}$ -inch lead pipe, 107 lbs.  $1\frac{1}{2}$ -inch lead pipe, 142 lbs. 2-inch lead pipe; 316 ft. 2-inch lead-lined iron pipe, 305 ft.  $1\frac{1}{2}$ -inch lead-lined iron pipe, 126 ft.  $1\frac{1}{4}$ -inch lead-lined iron pipe, 360 ft. 1-inch lead-lined iron pipe, 552 ft.  $\frac{3}{4}$ -inch lead-lined iron pipe; 100 ft.  $1\frac{1}{2}$ -inch iron pipe; 46 lead goosenecks. Corporation cocks, 1-inch, 20;  $\frac{3}{4}$ -inch, 281. Sidewalk cocks, 1-inch, 10;  $\frac{3}{4}$ -inch, 359. Cellar cocks, 1-inch, 9;  $\frac{3}{4}$ -inch, 524; 8  $\frac{3}{4}$ -inch compression cocks; 893  $\frac{3}{4}$ -inch thimbles for cocks; 463  $\frac{3}{4}$ -inch solder unions for cocks; 323  $\frac{3}{4}$ -inch screw tail unions for cocks, 212  $\frac{3}{4}$ -inch corporation solder unions; 80 1-inch sidewalk cock unions; 23 1-inch corporation unions; 135 iron stop-cock boxes. Crown Meters,  $1\frac{1}{2}$ -inch, 2, 1-inch, 8;  $\frac{3}{4}$ -inch, 26;  $\frac{5}{8}$ -inch, 30; Nash meters,  $\frac{3}{4}$ -inch, 7;  $\frac{5}{8}$ -inch, 11; Empire meters,  $\frac{3}{4}$ -inch, 1; Gem meters, 6-inch, 1; Hersey meters,  $\frac{5}{8}$ -inch, 5; Lambert meters,  $\frac{5}{8}$ -inch, 3; Trident meters,  $\frac{3}{4}$ -inch, 1; Worthington meters, 2-inch, 5;  $1\frac{1}{2}$ -inch, 3; 1-inch, 1;  $\frac{5}{8}$ -inch, 5; Frost meters,  $1\frac{1}{2}$ -inch, 2; 19 tops for  $\frac{3}{4}$ -inch Crown meters; 26 Tops for  $\frac{5}{8}$ -inch Crown meters; 9 tops for 1-inch Crown meters; 2 bottoms for  $\frac{5}{8}$ -inch Trident meters; 20 tops and ratchets for Worthington meters; 15 clocks for Worthington meters; 18 brass pistons for Worthington meters; 9 2-inch Peet valves with waste; 9  $1\frac{1}{2}$ -inch Chapman valves; 2  $2\frac{1}{2}$ -inch steam valves; 1  $\frac{1}{2}$ -inch steam valve. Brass elbows, 1 inch 65;  $1\times\frac{3}{4}$ -inch, 78;  $1\times\frac{1}{2}$ -inch, 12;  $\frac{3}{4}$ -inch, 61;  $\frac{3}{4}\times\frac{1}{2}$ -inch, 40. Brass nipples,  $1\times\frac{3}{4}$ -inch, 9. Iron Tee's,  $2\frac{1}{2}\times1\frac{1}{2}$ -inch, 1;  $2\times1\frac{1}{2}$ -inch, 3; 2-inch, 1;  $1\frac{1}{2}\times1$ -inch 1;  $1\frac{1}{2}$ -inch, 7;  $1\frac{1}{4}\times\frac{3}{4}$  inch, 2; 1-inch, 16;  $\frac{3}{4}$ -inch, 19. Iron Tee's lead-lined,  $2\times1\frac{1}{2}$ -inch, 1;  $2\times1\frac{1}{4}$ -inch, 1; 2-inch, 4;  $2\times\frac{3}{4}$ -inch, 13;  $1\frac{1}{4}\times1$ -inch, 6;  $1\frac{1}{4}\times\frac{3}{4}$ -inch, 4; 1-inch, 10;  $1\times\frac{3}{4}$ -inch, 10;  $\frac{3}{4}$ -inch, 9. Iron four-ways,  $2\times\frac{3}{4}$ -inch, 6;  $1\frac{1}{2}\times1$ -inch, 5; 1-inch, 10. Iron Y's,  $2\times1\frac{1}{2}$ -inch, 8. Iron Y's. lead-lined,  $2\times1\frac{1}{2}$ -inch, 10. Iron plugs, 1-inch, 93;  $\frac{3}{4}$ -inch, 67. Iron elbows,  $2\frac{1}{2}\times2$ -inch, 2; 2-inch, 1;  $2\times\frac{3}{4}$  inch, 1;  $1\frac{1}{2}$ -inch, 17; 1-inch, 70;  $1\times\frac{3}{4}$ -inch, 104;  $1\times1\frac{1}{2}$ -inch, 71,  $\frac{3}{4}$ -inch, 10;  $\frac{3}{4}\times\frac{1}{2}$ -inch, 60. Iron elbows, lead-lined, 1-inch, 8. Iron couplings, 2-inch, 193;  $1\frac{1}{4}\times1$ -inch, 3;  $1\frac{1}{4}\times\frac{3}{4}$ -inch, 3; 1-inch, 175;  $1\times\frac{3}{4}$ -inch, 44;  $1\times\frac{1}{2}$ -inch, 34,  $\frac{3}{4}$ -inch, 50;  $\frac{3}{4}\times\frac{1}{2}$ -inch, 70. Iron unions,  $2\frac{1}{2}$ -inch, 1; 2-inch, 6;  $1\frac{1}{2}$ -inch, 10; 1-inch, 90;  $\frac{3}{4}$ -inch, 100;  $1\frac{1}{8}$ -inch bends; 1-inch, 16. Iron nipples,  $2\frac{1}{2}$ -inch, 3; 1-inch, 110;  $\frac{3}{4}$ -inch, 85. Iron bushings,  $1\times\frac{1}{2}$ -inch, 170;  $1\times\frac{3}{4}$ -inch, 35; 11 complete Post Hydrant spindles; 3 Independent outlet valves for Chapman hydrant; 30 hydrant tops; 16 brass hydrant nipples; 21 leather vales for flush hydrants; 42 brass hydrant spindles; 14 bushings for post hydrants; 12 caps for hydrant nozzles; 1 30-inch gate spindle; 4 discs for gates; 70 brass gate spindles; 191 rubber gaskets for gates and hydrants; 24 caps for gate spindles; 12 brass nuts for stuffing boxes; 5 hydrant caps; 11 spindle heads for post hydrants; 8 iron plates for gates; 1 box of ring packing for 6-inch gates; 7 wooden hydrant boxes; 39 iron gate boxes; 50 lbs. rubber for packing; 170 lbs. Rainbow packing; 2 boxes 1-inch square



flax packing; 1 box  $\frac{1}{2}$ -inch square flax packing; 20 lbs. Eureka packing; 12 lbs. ring packing; 350 lbs. fine solder; 975 lbs. wiping solder; 150 lbs. steel; 500 lbs. iron; 1 can of powder; 3 cans of paint; 9 diaphragms for Edson pump; 2 harness hooks; 15 lead paper weights;  $\frac{1}{2}$  box toilet paper; 1 piston head for Deane pump; 4 lbs. brass checks; 25 lbs. tar paper; 10 lbs. tin and nails; 12 lbs. Dualin; 21 lbs. leather; 10 lbs. felt packing; 34 caulking hammer handles; 17 striking hammer handles;  $\frac{1}{2}$  bbl. of salt; 5 picks; 3 pick handles; 2 adze; 5 shovels; 2 lead pots; 1 top for Edson pump; 1 Douglas pump; 2 bales cotton waste; 1 battery and bell; 7 lbs. insulated wire; 3 boxes of tacks; 1 can Columbia metal polish; 5 monkey wrenches; 1 large can enamel black; 5 20-lb. sledge hammers; 20 lbs. iron castings for wheelbarrows; 1 casting for fountain; 3 cords wood; 1 load of bricks; 150 old gate and hydrant covers; 3 lbs. black enamel.

#### PROPERTY AND TOOLS AT SHOP, HAMPSHIRE STREET.

1 8x10 plain slide valve engine; 1 10-ft. engine lathe; 1 7-ft. engine lathe; 1 6-ft. brass finishing lathe; 1 5-ft. speed lathe; 1 shaper; 1 upright drill; 1 emery wheel; 1 grindstone; 2 soldering furnaces; 1 large end chuck; 2 independent chucks; 3 drill chucks; 10 lathe dogs; 19 reamers; 12 twist drills; 12 flat drills; 10 flat chucking drills; 30 turning tools; 10 steel arbors, 3 reamers for Desper meters; 15 taps; 3 tap wrenches; 1 hand vise; 4 bench vises; 2 pipe vises; 6 Stillson wrenches; 6 S wrenches; 13 hydrant wrenches; 9 post hydrant wrenches; 6 gate wrenches; 1 set chainfalls; 1 large platform scales; 2 small platform scales; 1 A. P. Smith tapping machine; 1 6-inch Kennedy valve; 9 die stocks; 30 dies; 8 pipe cutters; 6 pairs pipe tongs; 4 flush hydrants; 14 ft. rubber hose; 11 monkey wrenches; 1 nail puller; 1 30-inch; 1 24-inch; 1 16-inch; 2 12-inch; 1 8-inch; 2 6 inch, clips; 6 clamps; 4 levels; 2 blasting batteries with wires; 2 paving hammers; 12 rattan brooms; 1 gas radiator; 4 pipe hangers for E. Merrimack street bridge; 720 lbs. old brass; 3 sand screens; 3 gravel screens; 1 shaft hanger; 3 set caulking tools; 1 3-inch flange valve; 7 striking hammers; 9 caulking hammers; 12 cold chisels; 1 Railroad jack; 1 set blocks and rope; 1 crosscut saw; 3 Edson marine pumps; 11 lengths suction hose; 16 pair rubber boots; 4 tapping machines and rubbers; 6 taps and drills; 3 tap wrenches; 1 set plumbers tools; 2 naptha furnaces; 2 tin tunnels; 1 dark lantern; 2 2-inch chisels; 1 hatchet; 3 brass hand pumps; 1 2-inch auger; 5 hand saws; 3 pieces steel for ratchet; 100 ft. block tin tubing; 50 ft. block tin rod; 5 screwdrivers; 8 files; 1 pinch bar; 2 dust pans; 4 oil cans; 1 large oil can; 2 hydrant reducers for hose; 1 Norton door check and spring; 1 machine for testing meters; 1 chain; 1 set of bits; 1 set of chisels; 3 pair pliers; 1 pair round-nosed pliers; 2 soldering irons; 1 belt punch; 1 set steel figures; 1 set brass stencils; 1 naptha can; 2 hack saws; 1 pair scissors; 1 pair snips; 1 saw set; 3 desks; 1 small book case; 5 lbs. iron washers; 120 lbs. bolts; 2 gate plans; 1 750-gallon tank for testing meters; 1 forge; 1 anvil; 1 set blacksmiths tools; 1 draw shave; 1 marlin spike; 2 pails; 1 naptha lamp; 2 small meter wrenches; 1 L. W. W. seal; 1 set of tools for sealing fire services; 2 tool bags; 1 step ladder; 1 clock; 1 map of water mains; 2 chairs; 2 floor brushes; 1 mirror; 1 copper boiler;  $\frac{1}{2}$  can glue; 1 can for old waste; 1 lawn mower; 1 steel square; 1 piper's bench; 2 lead furnaces; 6 lengths 2 $\frac{1}{2}$ -inch hose; 1 nozzle; 2 dutchmen; 10 lbs. iron wire.

## PROPERTY AT SUPERINTENDENT'S OFFICE.

Two desks, three chairs, 1 set of drawers and book case, 1 letter press and stand, 1 hat rack, 1 Howard Electric Watch Clock, 1 gate plan. 2 diagrams, 1 picture, 15 framed notices.

## PROPERTY AND TOOLS AT TOOL HOUSE.

34 shovels, 25 picks, 28 pick handles, 37 mauls, 6 driving mauls, 3 lead pots, 4 set derrick falls, 5 chains, 11 striking hammers, 2 spoon shovels, 3 iron bars, 12 s. w. wrenches, 12 wrenches for hydrants and gates, 6 square pointed shovels, 16 hoes, 3 grub hoes, 1 scythe, 3 paving hammers, 2 hand saws, 2 caulking hammers, 2 claw hammers, 3 monkey wrenches, 3 iron rakes, 1 stone hammer, 5 ladles, 1 axe, 2 bucksaws, 2 lines, 1 screw jack, 1 sledge hammer, 7 crowbars, 5 wedges, 1 set caulking tools, 3 chisels, 3 cutters, 3 derricks, 12 wheelbarrows, 3 sawhorses, 1 sand sifter, 1 gravel sifter, 4 tool boxes, 2 sets iron falls, 1 portable forge, 75 ft.  $1\frac{1}{2}$ -inch rope, 4 paving mauls, 1 boat, 7 sling ropes, 10 tag ropes, 30 lanterns, 5 pails,  $\frac{1}{2}$  keg nails, 30 gallons oil, 12 lantern globes.

## PROPERTY AND TOOLS AT PUMPING STATION No. 1.

11 wrenches for high duty Worthington, 11 wrenches low duty Worthington, 11 wrenches for Morris engine, 8 sets brass boxes for engine, 4 spare valves for Morris engine, 2 oil dishes, 1 set oil cans, 1 oil filter, 1 work bench, 1 bench vice, 10 drills, 2 cold chisels, 3 bitstocks, 2 bits, 1 level, 1 key-hole saw, 1 hand saw, 1 hack saw, 5 monkey wrenches, 3 sledges, 1 copper hammer, 3 hammers, 4 socket wrenches, 1 2-ft. steel square, 2 jack screws, 1 tool cupboard, 2 set differential blocks, 1 pair gas pliers, 1 set fire irons, 1 brass hydrant, 2 platform scales, 1 hay scales, 2 step ladders, 5 ladders, 2 lanterns, 2 lawn mowers, 1 barometer, 3 thermometers, 1 truck, 2 iron wheelbarrows, 1 iron pail, 2 indicators, 3 steam gauges, 4 gauge glasses, 85 cakes soap, 3 brooms, 100 lbs. tallow, 1 gas lamp with tubing, 1 24-inch elbow, 1 blow-pipe with blower, 1 furnace pot, 1 tar kettle, 11 grate sections with bars, 1 10-inch valve, 2 clocks, 1 book case, 1 bed, 4 chairs, 1 table, 1 desk, 2 floor brushes, 2 mops, 1 dust brush, 1 dust pan, 4 Stillson wrenches, 5 cuspidors, 1 2-inch Jenkins valve, 2 extra check valves for High Duty Worthington, 1 set drawings high duty Worthington, 1 ratchet drill, 8 pairs pipe tongs, 9 pipe dies, 2 flue scrapers, 1 oil cupboard, 45 gallons cylinder oil, 40 gallons machine oil, 11 7-inch rubber valves, 6 10-inch rubber valves, 20 5-inch rubber valves, 25 lbs Italian flax, 200 ft. felting, 20 lbs. metallic packing, 25 lbs. waste, 45 lbs. Garlock packing, 10 lbs. Vulcabeston packing, 10 lbs. asbestos packing,  $5\frac{1}{2}$  ft. of  $1\frac{1}{2} \times \frac{1}{8}$ -inch Chesterton packing,  $1\frac{1}{2}$  ft. of  $1\frac{1}{2} \times \frac{7}{8}$ -inch Chesterton packing,  $14\frac{1}{2}$  lbs. Eureka packing, 13 lbs. Favorite packing, 10 lbs. square tuck packing, 16 lbs. woven wire packing.

## PROPERTY AND TOOLS AT PUMPING STATION No. 2.

One work bench and vise, 1 bit stock, 1 set of bits, 1 thermometer, 1 clock, 7 cold chisels, 4 monkey wrenches, 10 socket wrenches, 14 wrenches, 2 pinch bars, 2 gate wrenches, 3 steel drills, 1  $1\frac{1}{2}$ -inch pipe tongs, 1 1-inch pipe tongs, 1 sledge hammer, 1 coal hammer, 2 long steel chisels, 4 taps, 1 axe, 2 ice

chisels, 4 grapple rakes, 1 iron rake, 5 hand hole gaskets, 2 slicing bars, 1 boiler hoe, 2 long handle shovels, 2 iron wheelbarrows, 6 lamps, 1 platform scales, 1 30-ft. Howe platform scales, 200 ft. cotton hose, 2 brooms, 2 dust brushes, 1 map of Lowell, 3 Stillson wrenches, 1 gallon measure, 100 lbs. waste, 35 gallons spindle oil, 1 tunnel, 10 lbs. hemp packing, 2 oil cans, 1 glass pitcher, 1 dozen glasses, 8 valves and spindles for Deane pump, 40 valve plates, 40 springs, 1 desk, 4 chairs, 1 grindstone, 48 sheets emery paper, 2 files, 1 copper hammer, 2 ladders, 1 step ladder, 2 iron pails, 1 map, 25 ft. 1-inch hose, 2 picks, 2 shovels, 2 pair rubber boots, 1 2-inch die plate and dies, 1 1-inch die plates and dies,  $\frac{1}{2}$  bbl. Valvoline oil, 35 gallons spindle oil, 25 lbs. cotton waste, 2 2-inch pipe cutters, 1 6-inch pipe cutter, 2 caulking hammers, 1 5-gallon oil can, 1 box piston packing,  $\frac{1}{2}$  bbl. soda ash, 3 glass guages, 1 ring for water piston, 1 ratchet drill, 2  $\frac{3}{4}$ -inch taps.

#### PROPERTY AND TOOLS AT PUMPING STATION No. 3.

6 oil cup glasses, 5 wrenches and board for Worthington pumps, 1 18-inch monkey wrench, 1 12-inch monkey wrench, 1 8-inch monkey wrench, 2 Stillson wrenches, 4 guard wrenches, 3 off-set wrenches, 8 socket wrenches, 2  $\frac{3}{4}$ -inch iron bolts, 1  $\frac{1}{2}$ -inch iron bolt, 5 gallons cylinder oil, 7 gallons spindle oil,  $\frac{1}{2}$  box Columbia metal polish, 12 lbs. Rainbow packing, 1 box  $\frac{5}{8}$ -inch square flax packing, 2 tunnels, 1 hand saw, 1 clock, 1 dust pan, 1 brush, 1 broom, 1 2-inch scrape for well, 1 brass tray, 3 pair rubber boots, 2 oil cups, 3 6-inch valve studs, 6 6-inch rubber valves, 30 4-inch rubber valves, 3 packing hooks, 6 6-inch valve springs, 12 4-inch valve springs, 1 box  $\frac{5}{8}$ -inch Eureka packing,  $\frac{1}{2}$  box  $\frac{1}{2}$ -inch National packing, 1 box  $\frac{3}{4}$ -inch Eureka packing, 50 ft. fibrus packing, 6 lamp wicks, 7 lantern wicks, 1 step ladder, 1 8-ft. ladder, 1 12-ft. ladder, 2 stands, 1 9-ft. running board, 30 ft. 1 $\frac{1}{4}$ -inch hose, 1 bench, 30 ft.  $\frac{3}{4}$ -inch hose, 1 vise, 1 platform scales, 1 iron wheelbarrow, 2 coal shovels, 1 sledge hammer, 1 broom, 2 slice bars, 2 boiler hoes, 1 hook bar, 6 gate bars, 1 bearing bar, 50 ft.  $\frac{3}{4}$ -inch hose,  $\frac{1}{2}$  bbl. lime, 1 pail fire clay, 4 iron pails, 6 drip pans, 6 brass oil cans and tray, 1 2-quart can, 2 gate wrenches, 3 chairs, 4 dippers, 1 lantern, 3 B. & H. lamps, 2 large lamps, 1 bracket lamp, 1 shade lamp, 12 60-gallon oil tanks, 50 gallons kerosene oil, 1 waste can, 25 lbs. waste, 1 10-gallon can, 1 5-gallon can, 1 iron rake, 1 mop, 1 hoe, 1 24-inch flange, 2 shovels, 1 pick, 18 fire brick, 3 lamp chimneys, 8 B. & H. lamp chimneys, 1 strainer, 1 2-inch scraper, 20 ft.  $\frac{3}{4}$ -inch pipe, 1 faucet,  $\frac{1}{2}$  spool Vulcabeston packing, 1 bottle parafine oil, 2  $\frac{5}{8}$ -inch stud bolts, 2 fusible plugs, 1 1-inch Jenkins valve disk, 1 1 $\frac{1}{2}$ -inch Jenkins valve disk,  $\frac{1}{2}$  lb. wire, 2 lbs. hemp, 15 pieces  $\frac{1}{2}$ -inch fibrus packing, 1 desk, 36 ft. 8-inch pipe, 25 ft. 6-inch pipe, 6 ft. 5-inch pipe, 1 5-inch elbow, 1 6-inch elbow, 2 6-inch  $\frac{1}{8}$  turns, 3 6-inch couplings, 25 ft. 2-inch pipe, 1 6-inch flange, 1 5-inch flange, 20 ft. 1-inch pipe, 1 machine for driving wells, 2 screens, 1 2-gallon can black paint, 2 paint brushes, 1 white-wash brush, 1 1-inch valve, 1 1 $\frac{1}{4}$ -inch valve, 1 wooden wheelbarrow, 1 6-inch jack screw, 3 hand hole plates, 4 gaskets, 1 Venturi water meter, 11 ft. stove pipe.

#### PROPERTY AT STABLE.

7 horses, 8 single harnesses, 1 set double harness, 7 street blankets, 2 democrat wagons, 1 Goddard buggy, 7 sleighs, 5 wagons, 1 single truck, 1 double

truck, 7 stable blankets, 2 brooms, 6 brushes, 6 currycombs, 6 pitchforks, 7 rubber horse covers, 1 string of bells, 1 chamois skin, 1 box harness soap, 10 sponges, 1 wagon jack, 1 hay cutter, 2 feed boxes, 1 sprinkling can, 6 whips, 2½ tons of hay, 100 bushels of oats, 2 bags corn, 2 bags shorts, 2 bales straw, 3 lap robes, 1 wolf-skin robe, 15 lbs. grease, 2 pails, 1 can harness oil, 1 large sun shade, 2 wagon covers, 50 ft. 1-inch rubber hose.

#### PROPERTY AND TOOLS AT RESEVOIR.

1 boat, 2 lawn mowers, 1 scythe and snath, 1 wooden rake, 1 iron rake, 1 long handle shovel, 2 short handle shovels, 1 crow bar, 1 monkey wrench, 1 scuff hoe, 1 long handle hoe, 1 axe, 1 wooden shovel, 1 ice chisel, 1 broom, 1 lantern, 1 wheelbarrow.

#### MOVABLE FIXTURES AND PROPERTY AT OFFICE, CITY HALL.

Two roll-top desks, 2 standing desks, 1 double flat desk, 1 3-place inspector's desk, 1 2-place inspector's desk, 2 single inspector's desks, 2 heavy oak tables, 1 typewriter desk, 1 Remington typewriter, 1 small table, 1 vault table, 2 swivel upholstered chairs, 6 upholstered chairs, 12 cane seated arm-chairs, 8 swivel cane-seated chairs, 3 high chairs, 3 stools, 1 step chair, 1 settee, 1 bookcase, 1 water-tank, 2 water-pressure guages, 3 thermometers, 1 clock, 2 table gas lamps, 33 framed pictures—plans, etc.; 2 floor rugs, 2 rubber mats, 1 set street tools, 2 earthen spittoons, 6 brass spittoons, 6 waste paper baskets, 1 shovel (historic), 2 mirrors, 1 letter copying-press, 2 umbrella racks, 20 ink stands, 2 pen racks, 1 gas stove, 3 book racks, set tools (hammer, wrench, 2 screwdrivers, wire cutter, 1 plane, 1 saw, 1 chisel), 3 tumblers, boot-blackening outfit, 1 hair brush, 1 clothes brush, 1 dozen towels, 1 match chest, 1 fire-insurance map of Lowell, 1 atlas City of Lowell, 5 tin yearly boxes, 1 copy stand, 1 set Massachusetts statutes, 1 large dictionary, 1 large photo: album, 1 revolving book case,

# REPORT OF THE CITY ENGINEER.

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OFFICE OF CITY ENGINEER,

Lowell, Mass., January 1, 1897.

TO THE LOWELL WATER BOARD,

*Gentlemen*:—I have the honor to submit the Twenty-fourth annual report for the year ending December 31st, 1896, as follows :

## PUMPAGE.

The average cost of pumping one million gallons into the low service reservoir was sixteen dollars and sixteen cents (\$16.16).

The quantity pumped from the distributing mains of the low service into the high service reservoir was 36,877,428 gallons, and the cost of pumpage was eight dollars and twenty-eight cents (\$8.28) per million gallons. To this cost must be added the average cost of pumpage into the low service reservoir, viz., sixteen dollars and sixteen cents (\$16.16), making the total cost of pumpage into the high service reservoir for the year 1896, twenty-four dollars and forty-four cents (\$24.44) per million gallons.

The following table shows the source of supply, quantity pumped and cost at the several stations during the year 1896.

**TABLE SHOWING SOURCE OF SUPPLY, QUANTITY PUMPED AND COST AT THE SEVERAL  
STATIONS DURING THE YEAR 1886.**

	Source of Supply.	Cost.
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TABLE SHOWING WORK DONE WITH WORTHINGTON DUPLEX ENGINE FOR EACH MONTH

DURING THE YEAR 1896.

MONTHS.	No. of days pumping.	Average No. of hours pumping per day.	No. of hours pumping per month.	No. of strokes made per month.	Average No. of strokes made per minute.	Average head, including friction in feet.	Quantity pumped per month in U. S. gallons.	Average quantity pumped per day in U. S. gallons.	No. gals. of water pumped into reservoir per lb. total coal consumed.	Duty in lbs. 1 ft. high with 100 lbs. coal used in pumping only; no deduction for ashes or clinkers.	Duty on total coal consumed; no deduction for ashes or clinkers.
January.....	....	....	....	....	....	....	....	....	....	....	....
February.....	8	8-43	69-45	48,145	11.50	161.72	14,924,640	1,865,580	373	60,651,423	50,331,651
March.....	6	11-50	71-00	49,829	11.70	161.17	15,446,990	2,574,498	268	38,860,446	36,026,901
April.....	15	16-46	251-35	174,683	11.57	161.79	54,151,730	3,610,115	374	52,161,301	50,362,395
May.....	1	20-00	20-00	13,714	11.43	160.82	4,251,340	4,251,340	353	51,597,940	47,313,467
June.....	2	23-45	47-30	30,842	10.82	162.02	9,561,020	4,780,510	373	52,424,268	50,378,535
July.....	3	20-20	61-00	41,084	11.23	161.45	12,736,040	4,245,347	436	60,776,889	58,695,203
August.....	....	....	....	....	....	....	....	....	....	....	....
September.....	3	16-20	49-00	30,473	10.36	162.42	9,446,630	3,148,877	395	53,435,173	53,435,173
October.....	....	....	....	....	....	....	....	....	....	....	....
November.....	3	12-40	38-00	23,252	10.20	163.00	7,208,120	2,402,707	357	51,508,750	48,450,337
December.....	2	10-45	21-30	12,482	9.68	162.72	3,869,420	1,934,710	261	38,010,526	35,443,115
Totals and averages	43	14-38	629-20	424,503	11.24	161.83	131,595,930	3,060,370	357	51,125,965	48,183,440

TABLE SHOWING WORK DONE WITH WORTHINGTON HIGH DUTY ENGINE FOR EACH MONTH  
DURING THE YEAR 1896.

MONTHS.	No. of days pumping.	Average No. of hours pumping per day.	No. of hours pumping per month.	No. of strokes made per month.	Average No. of strokes made per minute.	Average head, including friction in feet.	Quantity pumped per month in U. S. gallons.	Average quantity pumped per day in U. S. gallons.	No gals. of water pumped into reservoir per lb. total coal consumed.	Duty in lbs. 1 ft. high with 100 lbs. coal used in pumping only; no deduction for ashes or clinkers.	Duty on total coal consumed; no deduction for ashes or clinkers.
January	2	9-15	19-30	19,616	16.77	163.33	7,336,000	3,678,000	589	91,937,646	80,161,167
February	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
March	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
April	3	11-10	33-30	18,924	9.41	163.50	7,006,500	2,365,500	563	87,130,620	76,756,281
May	30	21-55	657-15	353,345	8.96	163.68	132,504,375	4,416,813	699	100,251,478	95,334,022
June	28	23-39	662-00	373,908	9.41	164.32	140,215,500	5,007.66	747	102,337,075	102,337,075
July	29	23-08	670-15	407,085	10.12	164.21	152,656,875	5,264,030	736	103,324,000	100,684,803
August	30	22-25	672-30	379,132	9.40	164.28	142,174,500	4,739,150	736	103,871,148	100,805,012
September	29	21-08	613-05	329,080	8.95	164.27	123,405,000	4,255,345	700	101,242,704	95,843,733
October	29	19-31	566-00	294,994	8.69	164.33	110,622,750	3,814,578	605	91,326,604	82,837,558
November	29	18-44	543-30	270,386	8.29	164.44	101,394,750	3,496,371	595	92,838,298	81,510,925
December	31	20-10	625-15	292,894	7.81	164.39	109,835,250	3,543,073	597	88,352,796	81,730,434
Totals and averages	240	21-06	5,063-20	2,739,364	9.02	164.22	1,027,261,500	4,280,256	677	98,160,978	92,698,457



TABLE SHOWING AMOUNT OF COAL USED FOR MORRIS ENGINE  
AT PUMPING STATION DURING THE YEAR 1896.

MONTHS.	COAL CONSUMED.			
	For starting fires, in lbs.	When pump- ing, in lbs.	For banking fires, in lbs.	Total per month in lbs.
January.....	6,600	53,300	4,200	64,100
February.....	4,500	39,893	3,000	47,393
March.....	....	....	....	....
April.....	....	....	..	....
May.....	....	....	....	....
June.....	....	....	....	....
July.....	....	....	....	....
August....	1,600	22,195	400	24,195
September. ....	....	....	....	....
October.....	....	....	....	....
November...	....	....	....	....
December...	....	....	....	....
Totals.....	12,700	115,388	7,600	135,688

**TABLE SHOWING THE AMOUNT OF COAL USED FOR WORTH-  
INGTON DUPLEX ENGINE AT PUMPING STATION  
DURING THE YEAR 1896.**

Months.	Coal Consumed.			
	For starting fires, in lbs.	When pumping, in lbs.	For banking fires, in lbs.	Total per month, in lbs.
January .....	....	....	....	....
February .....	5,200	33,165	1,600	39,965
March .....	3,200	53,391	1,000	57,591
April .....	4,700	139,981	300	144,981
May .....	600	11,043	400	12,043
June.....	1,000	24,626	....	25,626
July .....	1,000	28,196	....	29,196
August .....	.. .	....	....	...
September .....	.. .	23,930	....	23,930
October.....	....	....	....	....
November .....	800	19,010	400	20,210
December.....	1,000	13,805	....	14,805
Totals .....	17,500	347,147	3,700	368,347

TABLE SHOWING AMOUNT OF COAL USED FOR WORTHINGTON  
HIGH DUTY ENGINE AT PUMPING STATION  
DURING THE YEAR 1896.

MONTHS.	COAL CONSUMED.			
	For starting fires, in lbs.	When pump- ing, in lbs.	For banking fires, in lbs.	Total per month, in lbs.
January . . . . .	1,200	10,891	400	12,491
February . . . . .	....	....	....	....
March . . . . .	....	...	..	...
April . . . . .	900	11,098	600	12,598
May . . . . .	5,700	180,297	3,600	189,597
June . . . . .	....	187,632	....	187,632
July . . . . .	3,900	202,194	1,400	207,494
August . . . . .	3,400	187,398	2,300	193,098
September . . . . .	6,100	166,871	3,300	176,271
October . . . . .	11,500	165,889	5,500	182,889
November . . . . .	13,800	149,675	7,000	170,475
December . . . . .	9,200	170,314	4,600	184,114
Totals . . . . .	55,700	1,432,259	28,700	1,516,659

TABLE SHOWING WORK DONE WITH WORTHINGTON HIGH SERVICE ENGINE FOR EACH MONTH DURING THE YEAR 1896.

MONTHS.	No. of days pump- ing.	Average No. of hours pumping per day.	No. of hours pumping per month.	No. of strokes made per month.	Average No. of strokes made per minute.	Average head, including friction in feet.	Quantity pumped per month in U. S. gallons.	Average quantity pumped per day in U. S. gallons.	No. gals. of water pumped into reser- voir per lb. total coal consumed.	Coal in lbs. used when pumping.
January . . . . .	9	7-47	70-00	183,696	43.74	71.62	2,571,744	285,749	300	8,572
February . . . . .	8	7-43	61-45	143,108	38.63	72.62	2,003,512	250,439	300	6,678
March . . . . .	8	8-19	66-30	152,990	38.34	72.20	2,141,860	267,732	300	7,151
April . . . . .	8	9-33	76-25	142,151	31.00	70.60	1,990,114	248,764	300	6,636
May . . . . .	9	11-20	102-00	213,972	34.96	65.97	2,995,608	332,845	300	9,993
June . . . . .	9	16-29	148-25	212,139	23.82	65.83	2,969,946	329,994	300	9,874
July . . . . .	30	23-29	704-30	276,373	6.54	67.75	3,869,222	128,974	300	12,898
August . . . . .	31	23-52	740-00	322,019	7.25	67.57	4,508,266	145,428	300	15,028
September . . . . .	25	23-41	592-00	246,234	6.93	69.44	3,447,276	137,891	300	11,491
October . . . . .	28	23-47	666-00	252,450	6.32	69.44	3,534,300	12,6225	300	11,771
November . . . . .	24	23-42	569-00	232,180	6.80	69.44	3,250,520	135,438	300	10,825
December . . . . .	29	22-33	654-00	256,790	6.54	69.44	3,595,060	123,968	300	11,971
Totals and averages...	218	20-25	4,450-35	2,634,102	9.86	69.00	36,877,428	169,163	300	122,888

**PUMPING STATION, MORRIS ENGINE, RUNNING  
EXPENSES FOR THE YEAR 1896.**

<b>Pay of engineers and firemen.....</b>	<b>\$341.04</b>
<b>65 1362-2000 tons of coal (Cumberland, 1895) at \$3.814....</b>	<b>250.51</b>
<b>2 326-2000 tons of coal (Cumberland, 1896), at \$3.705....</b>	<b>8.01</b>
<b>Electric light.....</b>	<b>12.66</b>
<b>Gas for lighting works.....</b>	<b>12 81</b>
<b>13.55 gallons of cylinder oil, at .535.....</b>	<b>7.25</b>
<b>4.69 gallons of engine oil, at .279.....</b>	<b>1.31</b>
<b>19 1-2 pounds of packing, at 1.922..</b>	<b>37.47</b>
<b>38.15 pounds of cotton waste, at .068.....</b>	<b>2.59</b>
<b>Repairs on engine.....</b>	<b>76.17</b>
<b>Repairs on boilers.....</b>	<b>4.67</b>
<b>Tools and stock.....</b>	<b>5.16</b>
<b>Sundries.....</b>	<b>.78</b>
<b>Total.....</b>	<b>\$760 43</b>

Cost of pumping water into reservoir per million gallons, \$8.97.

Cost of pumping water one foot high per million gallons, .05 56-100.

**PUMPING STATION, WORTHINGTON DUPLEX ENGINE,  
RUNNING EXPENSES FOR THE YEAR 1896.**

Pay of engineers and firemen .....	\$535.92
150 232-2000 tons of coal (Cumberland, 1895) at \$3.814.....	572.54
34 115-2000 tons of coal (Cumberland, 1896) at 3.705 .....	126.18
Electric light .....	19.89
Gas for lighting works .....	20.13
21.3 gallons of cylinder oil, at .535 .....	11.40
7.37 gallons of engine oil, at .279.....	2.06
13½ pounds of packing, at .431.....	5.82
59.95 pounds of cotton waste at .068.....	4.08
Repairs on boilers .....	7.33
Tools and stock .....	8.12
Sundries.....	1.23
Total. ....	\$1,314.70

Cost of pumping water into reservoir per million gallons, \$9.99.

Cost of pumping water one foot high per million gallons, .06 17-100,

**PUMPING STATION, WORTHINGTON HIGH DUTY ENGINE,  
RUNNING EXPENSES FOR THE YEAR 1896.**

Pay of engineers and firemen.....	\$3,995.06
65 842-2000 tons of coal (Cumberland, 1895) at \$3.814.....	249.52
692 1817-2000 tons of coal (Cumberland, 1896) at \$3.705.....	2,567.23
Electric light.....	148.25
Gas for lighting works.....	150.06
158.77 gallons of cylinder oil, at .535.....	84.94
54.94 gallons of engine oil, at .279.....	15.33
145.15-16 pounds of packing, at .795.....	116.08
446.9 pounds of cotton waste, at .068.....	30.39
Repairs on engine.....	28.49
Repairs on boilers.....	54.67
Tools and stock.....	60.50
Sundries.....	9.20
Total.....	<b>\$7,509.72</b>

Cost of pumping water into reservoir per million gallons, \$7.31.

Cost of pumping water one foot high per million gallons, .04 45-100.

## RESERVOIR, BEACON STREET, 1896.

Months.	Depth in feet.	Quantity in U. S. gallons.	Temperature in degrees.	
			Of water.	Of air.
January . . . . .	18.90	28,663,223	36.22	23 10
February . . . . .	19.03	28,888,596	36.33	26.98
March. . . . .	18.42	27,874,558	36.27	30.06
April . . . . .	18.92	28,702,140	44.46	47.96
May. . . . .	19.56	29,775,541	53.63	60.93
June. . . . .	18.94	28,736,916	62.40	66.27
July . . . . .	16.72	25,085,521	70.80	72.97
August. . . . .	14.98	22,289,074	70.94	70.77
September. . . . .	18.16	27,445,412	62.69	61.10
October. . . . .	17 41	26,200,199	57.91	48.57
November. . . . .	18.53	28,046,050	52.04	44.33
December. . . . .	18.76	28,438,219	45.57	27.53



TABLE SHOWING THE AVERAGE MONTHLY AND DAILY CONSUMPTION OF WATER FOR THE YEAR 1896.

Months.	Gallons per month.	Gallons per day.
January . . . . .	258,770,484	8,347,435
February . . . . .	230,802,089	7,958,693
March . . . . .	206,000,017	6,645,162
April . . . . .	201,710,394	6,723,680
May . . . . .	218,075,234	7,034,685
June . . . . .	212,796,816	7,093,227
July . . . . .	229,635,753	7,407,605
August . . . . .	218,820,368	7,058,722
September . . . . .	185,936,893	6,197,896
October . . . . .	185,090,465	5,970,660
November . . . . .	178,687,862	5,956,262
December . . . . .	211,264,521	6,814,985
Totals and averages . . . . .	2,537,590,896	6,933,308



THE  
MUSEUM  
OF THE  
CITY OF BOSTON

## SUMMARY OF STATISTICS.

REPORT OF 1896.

*In accordance with the recommendations of the New England Water Works Association.*

LOWELL WATER WORKS, MIDDLESEX COUNTY, MASS.

Population by census of 1895, 84,359.

Date of construction, 1870 to 1873.

Date of construction, High Service, 1881.

Date of construction, Driven Wells, 1893 to 1896.

Source of supply — Merrimack River, through filter gallery, filter bed and direct, also two hundred ten (210) driven wells in the valley of River Meadow Brook and one hundred sixty-nine (169) driven wells at Pawtucket Boulevard.

Mode of supply — Pumping to reservoir and pumping direct.

## PUMPING.

## 1. Builders of pumping machinery :

One engine, capacity 5,000,000 gals. in 24 hours, Henry G. Morris.

One engine, capacity 5,000,000 gals. in 24 hours, Henry R. Worthington.

One engine, capacity 10,000,000 gals. in 24 hours, Henry R. Worthington.

One engine, capacity 500,000 gals. in 24 hours, Henry R. Worthington.

One engine, capacity 3,000,000 gals. in 24 hours, The Deane Steam Pump Company.

One engine, capacity 3,000,000 gals. in 24 hours, The Deane Steam Pump Company.

One engine, capacity 3,000,000 gals. in 24 hours, Henry R. Worthington.

One engine, capacity 3,000,000 gals. in 24 hours, Henry R. Worthington.

One engine, capacity 3,000,000 gals. in 24 hours, Knowles Steam Pump Works.

One engine, capacity 3,000,000 gals. in 24 hours, Knowles Steam Pump Works.

2. Description of coal used :

(b) Kind, bituminous.

(c) Size, broken.

(d) Brand, Cumberland.

(e) Price per gross ton delivered, \$4.187.

(g) Wood, price per cord.

3. Coal consumed for the year, in pounds, 2,020,694.

4. Wood consumed for the year in pounds.

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=coal in lbs.=2,400.

3

5. Total fuel consumed for the year, in pounds, 2,023,094.

6. Total pumpage for the year in gallons, 1,243,616,790.

7. Average static head against which pumps work, 156.21.

8. Average dynamic head against which pumps work, 162.42.

9. Number of gallons pumped per pound of coal, 615.

10. Duty in foot pounds per 100 pounds of coal, using the following formula, making no deduction for starting or banking fires, or heating building :—

$$\text{Duty} = \frac{\text{Gallons pumped (6)} \times 8.34 \text{ (lbs.)} \times 100 \times \text{dynamic head (8)}}{\text{Total fuel consumed (5)}} = 83,267,615$$

COST OF PUMPING FIGURED IN PUMPING STATION EXPENSES OF  
\$9,584.85.

11. Per million gallons raised against average dynamic head (8) into reservoir, \$7.71.

12. Per million gallons raised one foot high (dynamic),  $.04 \frac{75}{100}$ .  
2 to 5 and 7 to 12 inclusive do not include driven wells.  
6 includes pumpage from driven well plant at Pawtucket Boulevard.  
Pumpage from driven wells in valley of River Meadow Brook, 1,295,515,097 gallons.
- 

## NEW SUPPLY.

### FIRST TUBE WELL PLANT.

It is over three years since pumping was begun at this plant, and I think by this time the most sceptical mind must be thoroughly convinced that there is a permanent supply of water here. This should now be made a permanent station, the remainder of the suction mains lowered, a permanent pumping station built and one high duty pump put in the place of one of the present Deane pumps. The other Deane pump should be reserved for use during repairs on the high duty pump. I would recommend that this work be begun as soon as possible, as the cost of pumping with the low duty pumps will always be a great burden to the department.

### SECOND TUBE WELL PLANT.

April 9th, 1896, I sent my certificate to the Water Board stating that the Hydraulic Construction Company had fulfilled its contract to supply the City of Lowell with not less than 2,000,000 gallons of ground water each and every day for one year. During the year's trial the company pumped 1,137,961,983 gallons, this being at the rate of 3,109,186 gallons per day.

The wells were therefore accepted according to the contract, and all the machinery, boilers and buildings put up by the contractors were purchased by the city at the contract price, which was seventy-five (75) per cent. of their cost. This settlement was satisfactory to both parties, and the plant was at once turned over to the regular Water Works Department and has been used when needed throughout the summer.

### THIRD TUBE WELL PLANT.

*Built by B. F. Smith and Brother, Boston, Mass.*

In closing my report last year I stated that "the wells had been driven and the suction mains were on the ground ready to be laid." This plant was finished and water pumped into the city conduit February 18th, 1896. The plant contains one hundred and sixty-nine (169) two and one-half ( $2\frac{1}{2}$ ) inch wells which vary in depth from twenty-seven (27) to forty (40) feet. They are connected by flanged suction pipe of the following sizes :

20 inch suction pipe	13 feet.
14 " " "	1152 "
12 " " "	326 "
10 " " "	170 "
8 " " "	130 "
6 " " "	265 "
<hr/> Total	<hr/> 2056 "

The suction mains are connected with a large horizontal air receiver, eleven (11) feet long and six (6) feet in diameter, and each pump is connected independently with the receiver. The suction mains are laid three (3) feet below the surface of the ground, upon a pile foundation, on a true grade declining from the pumps. Great care was taken by the contractor in making the suction mains, branches and all connections air tight. Every pipe and special was tested for air before it was

laid, and to our great surprise many of them which had passed the water test were found defective under this test; that this was a wise precaution has been well proven, as this plant has been very free from air.

The contractors have built a very neat wooden pumping station in which they have placed two ten (10) by eighteen inch by 18 inch Blake pumps, each having a capacity of 3,000,000 gallons per day. As the pumps deliver the water into a conduit here, only (4) feet above the plungers, and have never worked with a vacuum of over seventeen (17) inches, their work is very light.

This plant so far as tested has proved very satisfactory; it is still owned by the contractors who are nearing the end of their one year test. The pumping from this plant was begun February 28th and continued to March 2nd, when on account of high water in the Merrimack river the pump pit was flooded, and pumping stopped for a few days. At the same time a break occurred in the old brick conduit which connected the plant with the old pumping station, so that no water could be pumped until this was repaired and it was not until April 6th that regular pumping was begun here.

The following is a record of the pumping from April 6th, 1896, to January 1st, 1897 :

Date.	Average Pumpage per Day.	Pumpage per Month.
April 6th to May 1st.....	3,364,608 gallons.	47,455,021 gallons.
May .....	3,858,324 "	119,608,071 "
June.....	4,530,484 "	135,914,540 "
July.....	4,906,478 "	152,100,772 "
August.....	4,616,262 "	143,104,126 "
September.....	4,161,978 "	124,859,351 "
October.....	3,467,214 "	100,549,203 "
November.....	3,321,537 "	99,646,123 "
December.....	3,552,843 "	110,138,150 "
Total.....		1,033,375,357 "



Since July the superintendent of the Water Works has limited the amount of water pumped at this station, therefore it is impossible to state at the present time how much water could be obtained here.

#### ANALYSIS.

The State Board of Health has analyzed a sample of water from each well plant every month that the plants have been in operation, and one from the Merrimack River at the same time. A copy of the analysis has been kindly sent me as soon as possible, so that the quality of the water has been very carefully watched.

Inspector Thomas O. Allen has analyzed samples from the Smith well plant as often as once a week during the trial of that plant.

A copy of the analysis from the State Board of Health will be found annexed to this report.

#### CONCLUSION.

Authorized by a vote of the Water Board, I began on the third day of August, 1891, the work of finding a new supply of water for the City of Lowell by the use of driven wells. This search was long and at times discouraging, but successful at last, and on the 28th day of February, 1896, our city had an abundant supply of excellent water. Part of the city had well water supplied to it in September, 1893, but it was February, 1896, before the whole city had an adequate supply.

During all this time I have received from the Water Board, both past and present, great encouragement and hearty and continued co-operations, for which I desire to return earnest thanks. I would acknowledge the help which Inspector

Thomas O. Allen has so readily given, in analyzing the many samples of water, and also the kindness and assistance which I have received at all times from Superintendent R. J. Thomas.

Respectfully submitted,

GEORGE BOWERS,  
City Engineer.

COMMONWEALTH OF MASSACHUSETTS.—STATE BOARD OF HEALTH, LOWELL.  
WATER ANALYSIS.  
(PARTS IN 100,000.)

172	173	174	175	176	177	178	179	180	181	182	183	184	185	186	187	188	189	190	191	192	193	194	195	196	197	198	199	200	201	202	203	204	205	206	207	208	209	210	211	212	213	214	215	216	217	218	219	220	221	222	223	224	225	226	227	228	229	230	231	232	233	234	235	236	237	238	239	240	241	242	243	244	245	246	247	248	249	250	251	252	253	254	255	256	257	258	259	260	261	262	263	264	265	266	267	268	269	270	271	272	273	274	275	276	277	278	279	280	281	282	283	284	285	286	287	288	289	290	291	292	293	294	295	296	297	298	299	300	301	302	303	304	305	306	307	308	309	310	311	312	313	314	315	316	317	318	319	320	321	322	323	324	325	326	327	328	329	330	331	332	333	334	335	336	337	338	339	340	341	342	343	344	345	346	347	348	349	350	351	352	353	354	355	356	357	358	359	360	361	362	363	364	365	366	367	368	369	370	371	372	373	374	375	376	377	378	379	380	381	382	383	384	385	386	387	388	389	390	391	392	393	394	395	396	397	398	399	400	401	402	403	404	405	406	407	408	409	410	411	412	413	414	415	416	417	418	419	420	421	422	423	424	425	426	427	428	429	430	431	432	433	434	435	436	437	438	439	440	441	442	443	444	445	446	447	448	449	450	451	452	453	454	455	456	457	458	459	460	461	462	463	464	465	466	467	468	469	470	471	472	473	474	475	476	477	478	479	480	481	482	483	484	485	486	487	488	489	490	491	492	493	494	495	496	497	498	499	500	501	502	503	504	505	506	507	508	509	510	511	512	513	514	515	516	517	518	519	520	521	522	523	524	525	526	527	528	529	530	531	532	533	534	535	536	537	538	539	540	541	542	543	544	545	546	547	548	549	550	551	552	553	554	555	556	557	558	559	560	561	562	563	564	565	566	567	568	569	570	571	572	573	574	575	576	577	578	579	580	581	582	583	584	585	586	587	588	589	590	591	592	593	594	595	596	597	598	599	600	601	602	603	604	605	606	607	608	609	610	611	612	613	614	615	616	617	618	619	620	621	622	623	624	625	626	627	628	629	630	631	632	633	634	635	636	637	638	639	640	641	642	643	644	645	646	647	648	649	650	651	652	653	654	655	656	657	658	659	660	661	662	663	664	665	666	667	668	669	670	671	672	673	674	675	676	677	678	679	680	681	682	683	684	685	686	687	688	689	690	691	692	693	694	695	696	697	698	699	700	701	702	703	704	705	706	707	708	709	710	711	712	713	714	715	716	717	718	719	720	721	722	723	724	725	726	727	728	729	730	731	732	733	734	735	736	737	738	739	740	741	742	743	744	745	746	747	748	749	750	751	752	753	754	755	756	757	758	759	760	761	762	763	764	765	766	767	768	769	770	771	772	773	774	775	776	777	778	779	780	781	782	783	784	785	786	787	788	789	790	791	792	793	794	795	796	797	798	799	800	801	802	803	804	805	806	807	808	809	810	811	812	813	814	815	816	817	818	819	820	821	822	823	824	825	826	827	828	829	830	831	832	833	834	835	836	837	838	839	840	841	842	843	844	845	846	847	848	849	850	851	852	853	854	855	856	857	858	859	860	861	862	863	864	865	866	867	868	869	870	871	872	873	874	875	876	877	878	879	880	881	882	883	884	885	886	887	888	889	890	891	892	893	894	895	896	897	898	899	900	901	902	903	904	905	906	907	908	909	910	911	912	913	914	915	916	917	918	919	920	921	922	923	924	925	926	927	928	929	930	931	932	933	934	935	936	937	938	939	940	941	942	943	944	945	946	947	948	949	950	951	952	953	954	955	956	957	958	959	960	961	962	963	964	965	966	967	968	969	970	971	972	973	974	975	976	977	978	979	980	981	982	983	984	985	986	987	988	989	990	991	992	993	994	995	996	997	998	999	1000	1001	1002	1003	1004	1005	1006	1007	1008	1009	1010	1011	1012	1013	1014	1015	1016	1017	1018	1019	1020	1021	1022	1023	1024	1025	1026	1027	1028	1029	1030	1031	1032	1033	1034	1035	1036	1037	1038	1039	1040	1041	1042	1043	1044	1045	1046	1047	1048	1049	1050	1051	1052	1053	1054	1055	1056	1057	1058	1059	1060	1061	1062	1063	1064	1065	1066	1067	1068	1069	1070	1071	1072	1073	1074	1075	1076	1077	1078	1079	1080	1081	1082	1083	1084	1085	1086	1087	1088	1089	1090	1091	1092	1093	1094	1095	1096	1097	1098	1099	1100	1101	1102	1103	1104	1105	1106	1107	1108	1109	1110	1111	1112	1113	1114	1115	1116	1117	1118	1119	1120	1121	1122	1123	1124	1125	1126	1127	1128	1129	1130	1131	1132	1133	1134	1135	1136	1137	1138	1139	1140	1141	1142	1143	1144	1145	1146	1147	1148	1149	1150	1151	1152	1153	1154	1155	1156	1157	1158	1159	1160	1161	1162	1163	1164	1165	1166	1167	1168	1169	1170	1171	1172	1173	1174	1175	1176	1177	1178	1179	1180	1181	1182	1183	1184	1185	1186	1187	1188	1189	1190	1191	1192	1193	1194	1195	1196	1197	1198	1199	1200	1201	1202	1203	1204	1205	1206	1207	1208	1209	1210	1211	1212	1213	1214	1215	1216	1217	1218	1219	1220	1221	1222	1223	1224	1225	1226	1227	1228	1229	1230	1231	1232	1233	1234	1235	1236	1237	1238	1239	1240	1241	1242	1243	1244	1245	1246	1247	1248	1249	1250	1251	1252	1253	1254	1255	1256	1257	1258	1259	1260	1261	1262	1263	1264	1265	1266	1267	1268	1269	1270	1271	1272	1273	1274	1275	1276	1277	1278	1279	1280	1281	1282	1283	1284	1285	1286	1287	1288	1289	1290	1291	1292	1293	1294	1295	1296	1297	1298	1299	1300	1301	1302	1303	1304	1305	1306	1307	1308	1309	1310	1311	1312	1313	1314	1315	1316	1317	1318	1319	1320	1321	1322	1323	1324	1325	1326	1327	1328	1329	1330	1331	1332	1333	1334	1335	1336	133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COMMONWEALTH OF MASSACHUSETTS. STATE BOARD OF HEALTH, LOWELL.

WATER ANALYSIS.

PORTS IN HOURS.

No.	Date	Time of day	Appearance		Color	Taste	Hot	Residues			Ammonia		Nitrogen			Total	Remarks
			Light	Sediment				Total	$\frac{1}{2}$	$\frac{1}{4}$	Free	Total	In 100	In 100	In 100		
15,000	Dec. 23	10:30	Light	Slight	0.0	Distinctly muddy	Distinctly disagreeable	3.50	1.50	2.00	0.25	0.40	0.20	0.00	1.1	0.22	Merrimack River
16,000	Jan. 10	10:30	Slight	Slight	0.40	Faintly muddy	Vegetable and muddy	3.05	1.00	2.05	0.10	0.12	0.05	0.00	0.8	0.22	"
16,500	Mar. 15	10:30	Slight	Slight	0.10	Distinctly unpleasant	Distinctly disagreeable	2.60	1.00	1.60	0.10	0.12	0.05	0.00	1.1	0.22	"
16,669	Apr. 25	10:30	Clear	Clear	0.40	Faintly muddy and unpleasant	Distinctly muddy	2.50	1.00	1.50	0.02	0.15	0.11	0.07	0.9	0.22	"
16,630	May 19	10:30	Slight cloudy	Slight	0.25	Distinctly vegetable and muddy	Distinctly vegetable and sweetish	2.85	1.30	1.55	0.10	0.12	0.10	0.14	1.0	0.22	"
16,617	June 16	10:30	Slight	Slight	0.40	Distinctly vegetable	Distinctly vegetable and muddy	3.55	1.35	2.20	0.12	0.15	0.11	0.10	1.0	0.22	"
17,029	June 21	10:30	Slight green	Slight green	0.20	Distinctly vegetable	Distinctly vegetable and sweetish	3.50	1.30	2.20	0.10	0.14	0.14	0.22	1.3	0.22	"
17,254	Aug. 18	10:30	Clear	Clear green	0.25	Distinctly vegetable	Distinctly vegetable	3.70	1.40	2.30	0.12	0.15	0.15	0.21	0.8	0.22	"
17,471	Sept. 15	10:30	Slight	Clear	0.45	Distinctly vegetable	Distinctly vegetable and muddy	3.90	1.50	2.40	0.14	0.15	0.15	0.21	0.8	0.22	"
17,676	Oct. 20	10:30	Slight	Slight	0.75	Distinctly vegetable and muddy	Distinctly vegetable and muddy	4.45	1.70	2.75	0.10	0.15	0.17	0.23	1.0	0.22	"
17,677	Nov. 17	10:30	Slight	Clear	0.50	Distinctly vegetable and muddy	Distinctly vegetable and muddy	3.70	1.30	2.40	0.12	0.16	0.15	0.23	1.2	0.22	"
18,124	Dec. 15	10:30	Slight	Clear dusky	0.60	Distinctly muddy	Distinctly muddy	3.50	1.30	2.20	0.05	0.12	0.10	0.01	1.0	0.22	"

(PARTS IN 100,000.)

No.	DATE OF		APPEARANCE.			ODOR.		RESIDUE ON EVAPORATION.			AMMONIA.			Chlorine.	NITROGEN AS		Hardness.	Iron.	Oxygen Consumed.	REMARKS.
	Collection.	Examination.	Turbid- ity.	Sediment.	Color	Cold.	Hot.	Total	Loss on ig- nition.	Fixed.	Free.	Total	In so- lution.	In sus- pension.	Ni- trates.	Ni- trites.				
15,918	Jan., 1896. 21 22		Very Slight.	Very Slight.	0.03	None.	None.	9.80	....	....	.0000	.0036	....	....	.0420	.0001	4.0	.0110	.1014	Cook Wells.
16,020	Feb. 18 19		None.	None.	0.03	None.	None.	9.30	....	....	.0000	.0030	....	....	.0470	.0000	4.6	.0070	.0616	" "
16,263	Mar. 17 18		None.	Slight.	0.02	None.	None.	8.40	....	....	.0000	.0034	....	....	.0420	.0000	3.5	.0060	.0829	" "
....	April		Plant not running.				...	....	....	....	....	....	....	....	....	....	..	....	....	" "
16,622	May 19 20		None.	None.	0.00	None.	None.	7.90	....	....	.0006	.0031	....	....	.0350	.0000	3.4	.0050	.0858	" "
....	June		Plant not running.				...	....	....	....	....	....	....	....	....	....	..	....	....	" "
....	July		"				....	....	....	....	....	....	....	....	....	....	..	....	....	" "
....	Aug.		"				....	....	....	....	....	....	....	....	....	....	..	....	....	" "
....	Sept.		"				....	....	....	....	....	....	....	....	....	....	..	....	....	" "
17,679	Oct. 20 21		None.	None.	0.03	None.	None.	7.50	....	....	.0 02	.0018	....	....	.0800	.0002	3.3	.0070	.0932	" "
....	Nov.		Plant not running.				....	....	....	....	...	....	....	....	....	....	..	....	....	" "
18,125	Dec. 15 16		None.	None.	0.03	None.	None.	7.30	....	...	.0002	.0056	....	....	.0580	.0000	3.9	.0050	.0975	" "

**COMMONWEALTH OF MASSACHUSETTS.—STATE BOARD OF HEALTH, LOWELL.**

**WATER ANALYSIS.**

(PARTS IN 100,000.)

1892

1893

1894

1895

**COMMONWEALTH OF MASSACHUSETTS.—STATE BOARD OF HEALTH, LOWELL.**

**WATER ANALYSIS.**

(PARTS IN 100,000.)



1882

1883

1884

1885



1886

1887









**TWENTY-FIFTH**

**ANNUAL REPORT**

**OF THE**

**LOWELL WATER BOARD**

**TO THE**

**CITY COUNCIL OF THE CITY OF LOWELL, MASS.,**

**AND THE**

**REPORTS OF THE SUPERINTENDENT OF WATER WORKS**  
**AND OF THE CITY ENGINEER TO THE**  
**WATER BOARD FOR 1897.**

**LOWELL, MASS.:**  
**MORNING MAIL CO., PRINTERS.**  
**1898.**

42843  
50

## CITY OF LOWELL.

---

IN BOARD OF ALDERMEN, February 1, 1898.

Received and ordered on file; sent down for concurrence.

GIRARD P. DADMAN, *City Clerk.*

---

IN COMMON COUNCIL, February 1, 1898.

Received and ordered on file, in concurrence.

FRANK N. OWEN, *Clerk.*

# **WATER DEPARTMENT, 1897.**

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## **WATER BOARD.**

**FRANK L. WEAVER, *President.***

**Term expires second Monday in March, 1900.**

**AUGUST FELS,**

**Term expires second Monday in March, 1898.**

**STEPHEN H. JONES,**

**Term expires second Monday in March, 1893.**

**MICHAEL J. DOWD,**

**Term expires second Monday in March, 1901.**

**CHARLES E. HOWE,**

**Term expires second Monday in January, 1898.**

**J. W. CRAWFORD, *Secretary and Clerk.***

---

**ROBERT J. THOMAS, *Superintendent.***

**GEORGE BOWERS, *City Engineer.***

---

**D. B. H. BARTLETT, *Engineer.***

**WILLIAM JOYCE, *Asst. Foreman.***

**THOMAS MCLOUGHLIN, *Engineer.***

**JOHN E. LOWNY, *Meters.***

**FRANK LAPOINT, *Reservoir.***

**ARTEMAS S. YOUNG, *Foreman Shop.***

**THOMAS F. DOYLE, *Foreman.***

**A. F. COGER, *Hydrants and Gates.***

**THOMAS ROGERS, *Services.***

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## **OFFICE.**

**LEONARD T. FARRIS, *Service Clerk.***

**GERTRUDE W. BYAM, *Bookkeeper.***

**JULIA J. RAFTER, *Asst. Bookkeeper.***

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## **INSPECTORS.**

**ROBERT GARDNER, JR.**

**MICHAEL H. MCCUE.**

**GEORGE E. WORTHEN.**

**GEORGE F. TILTON.**

**WALTER P. WILEY.**



# REPORT OF THE WATER BOARD.

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OFFICE OF THE WATER BOARD,  
CITY HALL,

LOWELL, MASS., Jan. 1, 1898.

*To His Honor the Mayor and the City Council of the  
City of Lowell.*

The twenty-fifth annual report of the Water Board is herewith presented, being for the year ending December 31st, 1897.

There was but one change in the membership of the Board, Mr. Michael J. Dowd succeeding Mr. Putnam, whose term expired in March. The Superintendent and Clerk were re-elected.

On January 1st, 1897, the lease expired of a lot of land used as a pipe yard, belonging to the Proprietors of the Locks and Canals, situated between the Railroad and the Canal off School Street, for which the City pays \$290.00 per year rental. The Board decided it inexpedient to renew the lease for a term of years but occupy the premises as "tenants at will", as it is proposed to establish a pipe yard at Pumping Station No. 2 on land owned by the City, and have a spur track from the railroad which will permit of delivering coal and pipe on Water Works premises. We are now waiting for the railroad people to move in the matter.



The amended City Charter abolished the Reserved Fund from which the water for street fountains was paid, and no provision was made for charging this service to any other appropriation. The Committee on Appropriations was asked to provide the sum to pay for this service, and the Clerk of the Board appeared before the Committee to urge the claim but no attention was paid to the request. Section 21, Chapter 45, provides that "For water used by the City an account shall be made and the amount thereof shall be charged to the proper appropriation and credited to the Water Works", therefore it is proper and right that an appropriation from the general fund should be made to the Water Department for this purpose.

Owing to the rapid increase of building in the vicinity of the conduit near Moody Street in Pawtucketville, it became necessary for the Water Board in order to preserve the purity of the water supply to purchase the land on the line of the conduit, from the man hole where occurred the break in the tunnel near Gardner Avenue to Riverside Street, as follows :

Alfred McKercher	.	.	2319 sq. ft.
Jennie W. Revere	.	.	7633 sq. ft.
Ernest T. Genest	.	.	3515 sq. ft.
John H. Clancy	.	.	585 sq. ft.
Joseph D. Gadoua	.	.	6568 sq. ft.
Hermidas Gregoire	.	.	3335 sq. ft.
Joseph J. Richard	.	.	3443 sq. ft.
Patrick H. Clancy	.	.	1450 sq. ft.
Augustus L. Richards	.	.	1216 sq. ft.
Holden Heirs	.	.	15110 sq. ft.

Costing \$8652.48, and there has been sold to straighten lines to Paquette 361 feet and to Clancy 300 feet. There has also been purchased from the Bodwell Estate 27,163 sq.

## REPORT OF THE WATER BOARD.

feet which will cost about \$5,000.00 but the deeds have not yet passed into the hands of the City. This action gives the City control of the land over the conduit tunnel, which, with the building of the sewer now in course of construction for this territory, will protect the water supply from danger in that locality.

But now danger threatens from another source namely, the territory between Starbird Street and Mammoth Road through which the brick conduit passes, over which a street is laid out but not accepted. The City now owns a portion of the land. Houses are now being built on Waterford Street within a short distance of the conduit and water supply is asked for. It is imperative that this new street should be accepted and a sewer provided for this section.

In anticipation of the completion of the contract for the Boulevard Well Plant by Smith Brothers the Water Board on March 19th voted to ask the City Council to authorize a loan of \$50,000.00 for the Driven Wells and a resolution was introduced to that effect with the statement that "Any surplus remaining of this loan to be used to improve and increase the efficiency of the Well Plants and put them on a more permanent and economical basis under the advice and co-operation of the City Engineer". After the City Engineer certified that Smith Brothers had performed the terms of the contract satisfactorily and had a plant capable of producing four and one-half million gallons of water each and every day, Smith Brothers consented to accept pay on a basis of four million gallons if settlement was made by June 1st, 1897, making the sum necessary for settlement \$41,032.14. But owing to unfavorable action by the Committee on Financial Expenditures the loan was held up and finally killed in the Common Council August 4th. Councilman Taylor later introduced an order for a joint committee to meet with Smith Brothers

and arrange a settlement, which was finally concluded on the basis of four and one-half million gallons as follows :

Full payment for 2½ million gallons at \$13,461.70 . . .	\$33,654.25
Fourth payment of 25% on price two million gallons	6,730.85
Pumping Plant at 75% of cost . . . . .	7,377.89
	<hr/>
	\$47,762.99
Interest from April 17th . . . . .	1,560.26
	<hr/>
	\$49,323.25
Deduct as per agreement with Committee of City Council . . . . .	4,323.25
	<hr/>
	\$45,000.00

Thereupon a loan of \$41,000.00 was authorized which with the balance of \$4,000.00 on Driven Wells Account was sufficient to settle the claim. The City took possession of the plant Saturday night, November 6th, and soon afterward shut it down for the purpose of making repairs, it having been run continuously for a year and a half was in need of a thorough overhauling.

In the early summer at the beginning of hot weather complaints began to come in of the bad smell and taste of the water supplied from the reservoirs and more particularly that from the High Service. This evil was remedied by pumping directly into the mains, but this is a particularly delicate thing to do successfully as the consumption is bound to fluctuate more or less, depending largely on the weather. But this showing confirms the experience of other places using ground water, that where exposed to the light and air the water becomes tainted by the growth of algae, which although not unwholesome may become decidedly obnoxious. Another confirmation is the fact that the section of the city served from the wells on the south side of the city have no complaint from this cause, the water going directly into the

pipes from the wells without being exposed to the light and air. Owing to these conditions it is necessary that the water in the reservoirs must be protected either by a covered reservoir or a covered stand pipe. After investigation by the Board it was voted that the City Engineer should prepare plans for a steel stand pipe 40 ft. in diameter and 60 ft. high to be covered for the High Service system, to be placed at the northeast corner of the present High Service reservoir and be auxiliary thereto and would be of two-fold benefit inasmuch as it would give increased pressure for that system and also prevent the growth of algae.

The City Engineer's estimate of such a stand pipe is \$13,300.00 and it was calculated to pay for this out of the earnings of the department if the \$50,000.00 loan for wells was passed. But the loan having failed there were no funds available for this purpose; thereupon the Board sent a communication to the City Council asking for a loan of \$26,000.00 for the following named purposes:

\$15,000.00 for Stand Pipe.
\$6,000.00 for pipe through Gallery.
\$5,000.00 for land over Conduit.
<hr/>
\$26,000.00

The purpose of a pipe through the Filter Gallery is to keep the water in the filter gallery from mixing with the water from the wells, it being of a very inferior quality.

These being all permanent improvements of the system, it is proper that the expense of paying for them should be distributed over a term of years. But no action was taken by the City Council on the request except to refer it to the Committee of Financial Expenditures, who had one meeting with the Water Board on the subject.

On invitation of the Board of Health, a meeting was ar-

ranged with them to meet the Agents of the various corporations in relation to the matter of introducing city water into the mills and this Board offered to co-operate with any action that might be taken to improve the facilities for delivering city water to the operatives in the mills.

The interest in the meter question has continued and over 600 meters have been set at the request of water takers and the daily consumption of water was almost the same amount as in 1894 and is nearly half a million gallons per day less than in 1896; at the same rate of increase as occurred between 1894 and 1895 the city would have had to pump over one million gallons per day more than was done in 1897. But the effect of meters is also evident in the income of the department, for the charges for water decreased \$7,983.46 from the previous year. For the first time in the history of the Water Works the charge for metered water exceeded the charges for water by rates by \$9,577.16..

## 1897.

Charges for water . . . . .	\$222,524.42
Charges for labor and material . . . . .	17,110.86
Balance uncollected from 1896 . . . . .	28,696.28
	<hr/>
	\$268,331.56
Collections . . . . .	\$211,603.47
Discount . . . . .	22,117.00
Abated . . . . .	5,521.68
Due . . . . .	29,089.41
	<hr/>
	\$268,331.56
Balance January 1, 1897 . . . . .	\$36,279.81
Balance January 1, 1898 . . . . .	33,384.45
	<hr/>
	\$2,895.36 Decrease.

The balance on Driven Wells January 1st, 1897, was \$4,078.02 and \$41,000.00 was borrowed on this account,

all of which was expended and the Driven Wells account is now closed up.

The tables of the Secretary will show the financial working of the department in detail and the reports of the Superintendent and City Engineer will explain the work done in their respective departments.

**FRANK L. WEAVER,  
AUGUST FELS,  
MICHAEL J. DOWD,  
S. H. JONES,  
CHARLES E. HOWE.**

LOWELL WATER WORKS OFFICE,  
January 1st, 1898.

TO THE LOWELL WATER BOARD:

*Gentlemen* :— Herewith I submit figures detailing the finances of the Lowell Water Works for the year ending December 31st, 1897.

J. W. CRAWFORD, *Clerk*.

TABLE I. FINANCIAL STATEMENT—LOWELL WATER WORKS, 1897.

CHARGES.				RECEIPTS.					
Water.				By Accounts.					
Rate.	Metered.	Total.	Other than Water.	Total Charges 1897.	Total Charges 1896.	Receipts.	Discounts	Abatements.	Due.
Transfer .....	.....	.....	.....	\$28,636 28	\$32,571 09	\$24,803 64	\$2,515 92	\$295 85	\$1,080 87
January.....	\$75 70	\$78 70	\$ 11 34	900 04	2,424 76	926 20	13 41	30 18	11 25
February.....	63 23	63 23	1,684 58	1,747 81	1,006 90	1,547 15	7 28	9 83	183 55
March.....	86,516 25	\$25,828 61	.....	112,344 86	136,730 41	96,725 72	11,160 14	4,395 40	63 60
April.....	15,310 07	59 92	2,786 04	18,156 03	2,507 41	16,264 50	1538 54	203 69	149 30
May.....	1,764 45	1,764 45	1,915 96	3,680 41	4,671 19	3,274 69	170 70	193 80	51 22
June.....	656 66	35,568 45	1,420 16	36,988 61	34,986 98	33,123 41	3,540 80	73 63	260 77
July.....	553 51	1,196 25	2,492 35	3,688 60	2,239 73	3,364 41	117 28	47 34	159 57
August .....	269 49	272 71	1,586 10	1,858 81	2,367 62	1,723 96	28 83	26 74	79 29
September.....	815 70	29,542 22	1,166 81	30,669 03	31,36 24	27,183 02	2,890 56	192 59	402 86
October.....	245 04	245 02	1,548 39	1,793 41	2,130 13	1,316 33	22 79	53 63	400 66
November.....	129 74	130 90	991 88	1,122 78	1,334 05	336 31	1 84	.....	784 63
December.....	70 81	25,987 64	607 25	26,594 8	26,272 94	1,014 13	108 92	.....	25,471 84
Totals.....	\$106,473 63	\$116,050 79	\$17,110 86	\$268,331 56	\$280,612 45	\$211,663 47	\$22,117 00	\$5,521 68	\$29,069 41



TABLE II.

## FINANCIAL STATEMENT—LOWELL WATER WORKS, 1897.

## OUTGO.

	PayRolls and Salaries.	Water Works. Supplies.	Interest and Principal	Refunds and Va- cancies.	General Expense Account.	Stable De- partm't.	Reserv'r De- partm't.	Land.	COAL.				Pumping Well Water.	Totals.	
									P. S. 1.	P. S. 2.	P. S. 3.	P. S. 4.		1897.	1898.
January...	\$5,701 13	\$1,652 27	\$1,200 00	\$65 36	\$236 99	\$53 85	....	....	\$1,094 28	\$424 43	....	....	\$1,843 93	\$12,345 24	\$9,207 06
February..	3,608 11	353 80	8,100 00	23 64	205 88	192 23	....	....	....	....	....	....	1,309 19	13,792 86	20,268 59
March.....	3,746 23	7,574 09	600 00	14 16	798 11	178 98	....	....	....	....	....	....	1,259 20	14,169 57	14,599 53
April.....	4,906 81	6,125 12	100 00	40 00	249 82	71 50	....	2,266 50	2,356 04	1,000 32	1,238 38	....	1,052 93	20,006 42	20,000 80
May.....	7,338 57	2,021 95	16,040 00	1,367 23	151 78	83 63	2 50	6,385 98	1,265 40	1,276 84	1,223 47	....	906 03	38,063 38	38,554.38
June.....	6,178 61	4,150 80	4,640 00	80 24	606 76	66 60	38 80	....	....	231 19	....	....	792 70	16,785 70	17,753 24
July.....	5,994 54	2,096 40	11,480 00	211 72	133 24	23 85	44 52	....	43 20	16 10	....	....	1,162 01	21,205 58	20,374 06
August ...	5,124 56	2,004 81	2,200 00	62 97	144 14	608 62	13 14	....	....	....	....	....	1,010 90	11,169 14	14,699 17
September.	5,089 26	1,798 20	480 00	65 47	575 47	29 86	....	....	934 83	....	....	....	1,023 16	9,996 26	7,649 71
October....	5,705 93	2,175 98	10,020 00	99 29	367 20	57 15	....	....	546 22	....	....	....	1,066 97	20,058 74	21,053 69
November	4,871 61	1,265 00	19,360 00	34 17	342 88	52 97	....	...	....	....	....	305 29	178 07	26,409 99	27,066 69
December	4,712 45	2,022 56	3,520 00	2 70	149 03	40 98	....	....	....	....	....	46 10	...	10,495 82	7,363 06
Totals.....	\$62,977 81	\$33,254 98	\$77,740 00	\$2,067 75	\$4,019 30	\$1,460 23	\$98 96	\$8652 48	\$6,239 97	\$3,548 88	\$2,459 85	\$353 39	\$11,625 09	\$214,498 68	\$213,610 59

**TABLE III. FINANCIAL STATEMENT—LOWELL WATER WORKS, 1897.**  
**SUBDIVISION OF "OTHER THAN WATER CHARGES" FROM TABLE I.**

	Meters Sold.	Expense Setting Meters.	Meter Repairs.	New Services.	Relaid Services.	Labor and Material.	Lime Charges.	Shut-off Fees.	Sewer Flushing.	Totals.	
										1897.	1898.
January.....	\$528 50	\$57 10	\$23 76	\$132 66	\$17 75	\$72 87	\$56 70	\$6 00	\$16 00	\$911 34	\$2,263 80
February.....	1,199 00	139 89	36 93	80 23	12 25	27 54	164 74	4 00	20 00	1,634 58	909 68
March.....	....	....	....	....	....	....	....	....	....	....	....
April.....	1,875 50	214 99	1 25	331 21	157 04	51 45	114 60	16 00	4 00	2,786 04	1,640 77
May.....	1,405 00	161 43	....	236 12	65 99	24 26	17 16	4 00	2 00	1,915 96	1,862 93
June .....	790 00	82 11	....	281 86	204 35	16 60	39 24	2 00	4 00	1,420 16	2,478 73
July.....	1,490 10	163 10	9 35	489 92	232 42	22 96	36 50	40 00	8 00	2,492 35	1,630 96
August....	710 00	69 05	6 75	300 68	129 82	245 34	50 46	18 00	6 00	1,596 10	1,356 47
September.....	451 00	54 65	...	225 46	159 39	239 82	34 98	2 00	....	1,166 81	1,724 06
October.....	563 00	56 64	1 25	211 91	145 72	462 43	91 44	4 00	12 00	1,546 39	1,383 42
November .....	240 50	23 57	8 25	401 53	246 06	39 87	13 86	10 00	8 00	991 83	1,186 68
December.....	....	....	....	115 17	34 99	449 45	5 64	2 00	....	607 25	515 96
Totals.....	\$9,322 60	\$1,022 75	\$87 54	\$2,806 78	\$1,465 78	\$1,652 09	\$625 32	\$106 00	\$80 00	\$17,110 86	\$17,538 48

TABLE IV.

## FIANCIAL STATEMENT—LOWELL WATER WORKS, 1897.

## SUBDIVISION OF "PAY ROLLS AND SALARIES" FROM TABLE II.

	Salaries Presid'nt and Superin- tendent.	Office and Inspec- tors.	New Meter Work.	Meter Repairs.	Extension and Construc- tion.	Pumping Stations.				Mainten- ance.	Reser- voir.	New Services.	Relaid Services.	Recharged Sundry Persons.	Totals.	
						Station 1.	Station 2.	Station 3.	Station 4.						1897.	1896.
January ..	\$183 33	\$1,000 72	\$146 75	\$194 50	\$491 06	\$596 01	\$615 66	\$464 37	.....	\$1,758 57	\$69 03	\$128 51	\$ 52 62	.....	\$5,701 13	\$4,068 81
February..	183 34	667 40	100 34	140 04	169 86	469 39	350 24	368 13	.....	982 58	46 04	93 75	27 00	.....	3,608 11	4,116 50
March .....	183 33	667 40	58 39	162 00	108 11	442 03	308 84	390 78	.....	1,272 05	46 04	73 01	34 25	.....	3,746 23	6,199 90
April .....	183 33	667 40	119 38	103 36	1,035 97	486 58	276 84	355 89	.....	1,176 64	46 04	273 13	182 25	.... ..	4,906 81	5,244 27
May .....	183 34	834 25	164 00	147 25	2,206 16	543 57	316 81	545 65	.....	1,820 48	57 55	314 20	200 31	\$ 5 00	6,178 61	7,894 50
June.....	183 33	667 40	79 38	148 87	2,442 72	418 26	322 34	295 58	.....	1,114 31	46 04	276 65	183 73	.....	7,338 57	5,684 08
July .....	183 33	834 25	142 13	248 62	1,021 94	558 03	443 26	280 64	.....	1,475 24	57 55	426 31	266 74	38 50	5,994 54	4,927 04
August.....	183 34	667 40	125 63	132 31	698 88	460 97	278 66	326 85	.....	1,684 41	46 04	272 07	218 25	29 75	5,124 54	5,676 56
September	183 33	667 40	96 89	125 74	788 82	434 72	382 48	231 98	.....	1,739 86	46 04	234 00	146 06	11 94	5,089 26	4,725 10
October...	183 33	834 25	175 31	202 44	979 91	562 82	476 30	163 56	.....	1,553 29	57 55	232 25	218 80	66 12	5,705 43	5,483 96
November.	183 34	667 40	115 50	138 62	779 61	407 47	333 94	339 42	\$234 31	1,057 18	46 04	268 70	300 08	.....	4,871 61	4,625 24
December.	183 33	667 40	70 76	150 49	804 23	370 72	422 36	363 00	270 47	1,157 45	46 04	93 36	57 67	55 17	4,712 45	3,486 19
Totals...	\$2,200 00	\$8,842 67	\$1,394 46	\$1,894 24	\$11,535 27	\$5,750 57	\$4,537 73	\$4,125 85	\$504 78	\$16,792 06	\$610 00	\$2,696 94	\$1,887 76	\$206 48	\$62,977 81	\$62,132 15

TABLE V.

## FINANCIAL STATEMENT—LOWELL WATER WORKS, 1897.

## SUBDIVISION "WATER WORKS SUPPLIES" FROM TABLE II.

Pumping Station, No. 1, supplies.....	\$1,094 43
Pumping Station, No. 2, supplies.....	470 80
Pumping Station, No. 3, supplies.....	1,842 44
Pumping Station, No. 4, supplies.....	353 19
Iron pipe and specials.....	9,149 45
Hydrants .....	1,409 48
Gates, valves, and brass fittings.....	1,273 47
Lead pipe, pig lead and solder .....	4,177 47
Meters.....	9,342 22
Sidewalk and gate boxes .....	1,171 23
Machinery and tools.....	212 63
Miscellaneous stock.....	2,758 17
Total.....	<u>\$33,254 98</u>

TABLE VI.

FINANCIAL STATEMENT—LOWELL WATER WORKS, 1897.  
 DETAIL OF "PRINCIPAL AND INTEREST" FROM TABLE II.

## WATER LOAN BONDS:

Coupon No. 11, May, 1896, 16 @ 20 . . . . .	\$ 320 00	
No. 12, Nov., 1896, 73 @ 20 . . . . .	1,460 00	
No. 13, May, 1897, 984 @ 20 . . . . .	19,680 00	
No. 14, Nov., 1897, 980 @ 20 . . . . .	19,600 00	
	<u>                    </u>	\$41,060 00

## HIGH SERVICE LOAN:

Coupon No. 31, May, 1897, 15 @ 100 . . . . .	\$1,500 00	
No. 30, Nov., 1897, 15 @ 100 . . . . .	1,500 00	
	<u>                    </u>	3,000 00

## NOTES:

Lowell Inst. for Savings, 6 mos., \$30,000.00	}	\$1,080 00	
6 mos., 24,000.00			
1 year, 40,000.00 . . . . .		1,400 00	
1 year, 60,000.00 . . . . .		2,400 00	
		<u>                    </u>	4,880 00

## COMMONWEALTH OF MASS.:

1 year, \$75,000.00 . . . . .	\$2,800 00	
	<u>                    </u>	2,800 00
		<u>                    </u>
		\$51,740 00

## PRINCIPAL PAYMENTS:

Engine Loan . . . . .	\$6,000 00	
Driven Wells Loan . . . . .	10,000 00	
Driven Wells Loan . . . . .	5,000 00	
Driven Wells Loan . . . . .	5,000 00	
	<u>                    </u>	\$26,000 00
		<u>                    </u>
		\$77,740 00

## TABLE VII.

## FINANCIAL STATEMENT—LOWELL WATER WORKS, 1897.

## DRIVEN WELLS ACCOUNT.

January 1, 1897, balance.....	\$4,078 02	
Received from loan.....	41,000 00	
	<u>          </u>	\$45,078 02
Expended for Services.....	\$78 02	
Purchase Boulevard Plant.....	45,000 00	
	<u>          </u>	\$45,078 02

## TABLE VIII.

## FINANCIAL STATEMENT—LOWELL WATER WORKS, 1897.

## MAINTENANCE AND CONSTRUCTION STATEMENT.

## MAINTENANCE.

## PAID FOR LABOR:

Office and Inspectors.....	\$8,842 67
President and Superintendent.....	2,200 00
Pumping Stations.....	14,918 93
Meter Repairs.....	3,288 70
General Maintenance.....	18,679 82
Reservoir.....	610 00

## PAID FOR MATERIAL:

Output as per Stock Book.....	\$3,432 01
Interest.....	51,740 00
General Expense.....	4,019 30
Stable.....	1,460 22
Reservoir.....	98 96
Machinery and Tools.....	212 63
Pumping Station Supplies.....	3,760 86
Coal.....	12,602 09
Water—Contract P. S. No. 4.....	11,625 09
	<hr/>
	\$137,491 28

## CONSTRUCTION.

## PAID FOR LABOR:

Extension, Construction and New Services....	\$14,231 21
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## PAID FOR MATERIAL:

Output as per Stock Book.....	\$11,713 35
Payments on Loans.....	26,000 00
Land.....	8,652 48
	<hr/>
	\$60,597 04

# SUPERINTENDENT'S REPORT.

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LOWELL, MASS., Jan. 1, 1898.

TO THE LOWELL WATER BOARD :

*Gentlemen:* I have the honor of presenting you herewith the Annual report of the Superintendent of Water Works for the year ending December 31st, 1897, and in doing so it is gratifying to be able to state that no part of the city's water supply during the year was taken from the Merrimack River. Furthermore that at the present rate of consumption our system of wells can be depended upon to supply a sufficient quantity of water for several years to come. In this connection it can also be truly said that despite predictions to the contrary, there is no evidence of any diminution in the yield of wells. In fact, at no time during the year past did it become necessary to force them to anything approaching their maximum capacity.

The following figures give the total number of gallons of water consumed during the year and the various sources of supply ;

From Filter Gallery, Station No. 1	165,980,022 galls.
From Cook Wells, Station No. 2	541,704.942
From Hydraulic Wells, Station No. 3	511,811,330
From Boulevard Wells, Station No. 4	1,186,744,158
From balance in Reservoir	702,562
Total	<hr/> 2,406,943,014 galls.



These figures show a decrease of 131,350,444 gallons as compared with the total consumption of 1896.

That part of the City's supply derived from the Filter Gallery is objectionable and could be dispensed with, but under existing conditions its use is unavoidable until the 24-inch pipe ordered by your Honorable Board and now on the ground, is laid from the present terminus of Boulevard pipe to the Inlet Chamber. Thus, instead of discharging the well water into the Filter Gallery, conducting it to a point beyond the gallery making it practicable to shut the water off from that source entirely.

Notwithstanding the mixture of this undesirable water, it did not materially affect the character of the supply as a whole, nor does it alter the fact, that the quality of the water supplied the past year, is a vast improvement over the Merrimack River water, the truth of which is not only attested by the favorable opinion of the public generally, but is also borne out by the returns at the Board of Health Office, showing the lowest typhoid fever death rate for years. Early last summer complaint was made by people supplied from the High Service reservoir on account of a strong odor and taste to the water. This was simply a repetition of the trouble experienced the year before occasioned by the growth of algae in the open reservoirs. The recommendation of Your Honorable Board for a covered stand pipe, will, when adopted, prevent a recurrence of this trouble as far as the High Service is concerned and after that is accomplished, some such plan should be followed for the Low Service. It is well understood that the only permanent remedy is the exclusion of light from the water in storage. When the trouble arose last summer, it was treated in the same manner as the previous year by delivering the water into the distribution pipes before entering the reservoirs. This arrangement,

though effective, from the conditions governing the case, cannot be considered more than temporary. It does not prevent the growth of algae in the reservoir, it simply supplies the water direct from the pumps for consumption. It is also very expensive, requiring as it does, continuous running of the pumps during the algae season from April to October, thereby increasing the cost of pumping. Already the maintenance expense of the department is too high; due in a large measure to the extra cost of pumping well water at four separate Pumping Stations amounting to \$16.48 per million gallons the past year, against \$6.21 per million gallons, the cost of pumping Merrimack River water with one station in 1892.

Nevertheless, the people have a right to expect the best possible water and nothing has been left undone or expense spared by the Department to deliver the water in its original purity to the consumer. Hence the continuous running of the pumps when the interests of the water takers demanded it; in the summer on account of algae and in winter to avoid roiling the water in the street mains which follows the stopping and starting of No. 2 and 3 Pumping Stations. As some steps have been taken looking to relief from algae, probably this time would be the opportune one for bestowing some thought on the best plan of obviating the trouble with roily water in handling the last two mentioned stations. At present the water is pumped directly into the distributing system. Last year the laying of a large main pipe connecting with the reservoir was suggested as an improvement but no further action was taken. It might be worth while this year to consider the advisability of a covered stand pipe or large tank located at some high point on the Highlands and connected directly with the pumps of No. 2 and No. 3 Stations. If large enough, it would allow for the shutting

down of the pumps a part of each day. It might be feasible to have it supply a certain district independent of the reservoir. In that case by increasing its height, higher pressure for fire protection could be obtained where it is now much needed.

Particular attention has been given during the year towards preserving the Filter Gallery, Conduit, Pump Wells, Force Mains, Reservoirs and Street Mains of the Water Works clean and free from contamination. Appreciating the importance of thus guarding the water from possible pollution, the Water Board of 1896, fearing that the rapid growth in population of that part of Pawtucketville near the extension of Moody Street might endanger the safety of the Conduit and the purity of the water flowing through it, by percolation from dry wells on Gardner Ave., Gershom Ave. and Moody Street and also by impregnated surface water, strongly urged upon the City Council in their annual report the need of a system of sewerage for that locality. The City Council having acted favorably in the matter, the work was done during the past year. That it affords valuable protection to that part of the Conduit goes without saying. However, there is still another long stretch of this same Conduit running from the River Inlet House on Starbird Street to Mammoth Road opposite Third Avenue unprotected. The land in this vicinity is now being built upon and in a short time this portion of the Conduit will be subject to contamination unless proper drainage is provided at an early date.

Purchasing the land along the line of the Conduit from Gershom Avenue to Riverside Street by Your Honorable Board was a far-sighted move and cannot fail to prove of value to the City. Had it not been for your timely action the two tenement houses then in process of erection directly over the Conduit would now be completed and occupied,

followed, no doubt, by the construction of other buildings, which aside from the obstruction they would offer to the proper maintenance of the Conduit, the fact of a number of people dwelling within such close proximity would of itself be a certain source of pollution and ultimately ruin it for Water Works purposes.

The land over where the break occurred in the tunnel at shaft No. 1 has since its purchase been filled and graded to the level of Moody street. Twenty-five hundred loads of sand were used for this purpose, all of which were given the Department through the generosity of Miss Elizabeth B. Bodwell. At some future time when the filling is thoroughly settled this lot of land should be fenced and sodded.

A manhole was left in the Sarah Avenue sewer for the purpose of connecting with the old drain over the Conduit between Sarah Avenue and Moody Street. This drain, which now pitches the wrong way should be rebuilt to a proper grade and entered into the sewer as soon as possible.

### PUMPING STATIONS.

The acquirement from B. F. Smith & Brother of the Boulevard Well Plant on the 6th of last November gives the Department four Pumping Stations with pumping machinery of thirty-eight millions capacity. All of the station buildings are in good condition with the exception of No. 3, and that considering its flimsy and unsubstantial construction is in very fair condition.

The Pumps outside of those at Station No. 1 are of an inferior grade and very expensive to operate but will answer the purpose under present conditions. The boilers have all been examined recently by the insurance inspector and pronounced by him to be in first class order. Changes and repairs have been made at the different stations as follows :

## STATION No. 1.

New springs were set on the accumulator of the High Duty Worthington pump and new leather packings were riveted on the foot valves of the same pump. Two new glands were placed on the High Service pumps, both of the old ones being broken. New mouth pieces were set on No. 1 boiler and the fire box repaired. When No. 1 and No. 2 boilers were set up, a wrought iron heater was built in the flue between the two boilers; this has caused more or less annoyance from time to time, so finally it was decided to remove it during the past year, and the water feed pipes connected to it were replaced by brass pipe running along the front of the boilers with risers leading to the top and thence to the inlet, making the piping uniform on all the boilers. Nearly all the pumping at this Station was done by the High Duty Worthington.

## Cost of pumping per million gallons at this Station :

High Duty Worthington	\$7.79
Low Duty Worthington	\$9.79
High Service Worthington	\$10.38

Amount of water pumped into High Service Reservoir . . . . .	45,082,716 galls.
Amount of water pumped in 1896 High Service Reservoir . . . . .	36,877,428 galls.
Excess last year over 1896 . . . . .	<u>8,205,288 galls.</u>

## STATION No. 2.

The repairs at this Station consisted of an entire new set of valves and springs for the suction end of both pumps and a new set of grates for the boilers.

Cost of pumping per million gallons, at this Station \$16.14.

## STATION No. 3.

During a large portion of the year this Station could be stopped and closed but for the fact that the old walls and floor constructed by the Hydraulic Construction Company leaked to such an extent that it was necessary to keep a man on duty all the time to pump the water from the pit, otherwise the water would rise so as to submerge the pumps. In order to make a saving in this direction pursuant to a vote of Your Honorable Board, the Department undertook to remedy the defect. With that end in view the old engine pit, 18 x 22 feet inside measurement, being considered too small, was enlarged to the dimensions of 31 x 34 feet, affording ample room for future development. The foundations or footings for the new walls consist of a bed of cement concrete 1 foot thick and 4 feet wide, mixed one part cement, two parts sand and five parts stone. The mason work is 11 feet high and 20 inches thick consisting of two 8-inch walls of best quality of hard burnt brick tested for absorption, laid in Portland cement mortar mixed one part cement to one part of clean, sharp sand. All joints were filled, and the exterior faces of the walls were plastered smooth with "neat" Portland cement. Between the two 8-inch walls, a space 4" wide was filled with grout mixed with equal parts of cement and sand. Across the centre under the floor was laid a cement truss composed of old bricks, stones and broken concrete, etc., three feet thick in the middle and tapering up to the footings under the wall. The floor, consisting of one part cement, two parts sand and five parts stone was laid one foot thick and top dressed to a smooth surface.

Each wall is strengthened by two pieces of best quality "tee" iron bolted vertically to the walls and attached to "deadmen" sunk in the ground outside and brought to pro-

per bearings by means of turn buckles. In one corner of the pit a piece of 30-inch pipe 6 feet long with an iron bottom is set for use as a drainage well. In enlarging the pump pit the walls under the north and west sides were removed and replaced by substantial wooden posts. A suitable gravel roof containing two skylights was placed over the portion of the new pit projecting beyond the old building

The pumps at this station are in keeping with the building and if used much will require replacing before many years.

New mouth pieces were set in both boilers and the fire boxes repaired during the year.

Cost of pumping per millions gallons at this Station, \$15.54.

#### STATION No. 4.

Since assuming control of the Boulevard Well Plant, the Pumping Station now known as No. 4 has undergone a thorough overhauling. No. 1 boiler which had settled two inches was raised into position and the boiler front and brick setting which were found out of plumb were taken down and rebuilt. Due no doubt to the settling of the boiler, the main steam pipe leaked badly and had to be taken apart: this was done and in reconnecting the line of the pipe was altered so as to give it better support and to render it less likely to act as a siphon from the boilers. The valves of the feed water pipes which originally were set on top of the boiler opposite the safety valves were removed to a position more accessible. In doing this latter work the feed pipes were found to be worthless from corrosion and were replaced by lead lined iron pipes. The fire boxes of both boilers were in bad condition; they were rebuilt and fitted with new cheek and arch pieces. After making other minor repairs, a judicious appli-

cation of paint and whitewash gave everything a first rate appearance.

A set of platform scales should be placed at this station for weighing coal and additional storage for coal ought to be provided.

Figuring the cost of pumping at this station on the basis of \$10.00 per million gallons paid B. F. Smith & Brother and the expense of pumping 71 million gallons by the Department while the boiler, etc., were undergoing repairs, including wages of men employed on repairs, makes \$10.21 per million gallons. This cost will be materially reduced during the coming year.

### DISTRIBUTING MAINS.

There were laid during the year 24,330 feet or 4.608 miles of cast iron distributing pipe which is 4,910 feet in excess of the previous year, and deducting 1,823 feet laid in place of smaller cast iron mains, leaves 122.33 miles of pipe now in use. The longest piece of pipe laying was the 12 and 10-inch line on Wilder and Princeton Streets of 5,150 feet. Next to that was the Moody Street pipe westerly from Colonial Avenue amounting to 1,288 feet of 12 and 10-inch pipe. In connection with the extension of mains 73 new gates were set. Also included in the extensions are eight new fire services as follows :

American Card Clothing Co., Broadway	4" pipe.
State Normal School, Broadway . . .	4" pipe.
Street Dept. Yard, Broadway . . .	6" pipe.
St. Peters Church, South Street. . .	4" pipe.
Stirling Mills New Store House. . .	6" pipe.
Bartlett School, Wannalancit Street .	4" pipe.
American House Block, Warren Street .	6" pipe.
Associate Building, Worthen Street .	6" pipe.



## HYDRANTS.

Thirty-four new hydrants were set during the year, making a total of 1109 hydrants now in use. Fifteen old hydrant boxes have been replaced by new, and fifty-three hydrants came in for repairs, of which seven had to be removed and replaced with other hydrants.

## EXTENSION OF SMALL PIPE.

In courts and streets where it was deemed inadvisable to lay cast iron mains, lead lined iron pipe was laid to the amount of 1,795 feet. Lead lined iron pipe was selected for the above work, on account of its superior durability.

## LOW SERVICE, LEAD LINED PIPES LAID IN 1897.

Streets.	Location.	Length in feet.		Total.
		1½-in.	2-in.	
Arthur Avenue .. .. .	from Fifth Avenue southeasterly.. .. .		180	180.0
Brickett Court .. .. .	from Smith St. easterly.....		135	135.0
Caddell Avenue.....	from Crescent St. easterly.....	238		238.0
Fowler Road.....	to H. G. Cushing's Stable.....		145	145.0
Highland Avenue.....	from Parker St. southerly.....		132	132.0
New Court.....	off Walker St .. .. .	117		117.0
Parker Street.....	from Stevens St. westerly .. .. .		567	567.0
Robert Court.....	from Fifth Avenue southeasterly.....	125		125.0
West Bowers Street.....	from Wannalancit St. easterly.....	206		206.0
	Laid in 1897.....	686	1109	1795.0

## SERVICES.

According to the appended tables the service work for new and old services is fully as large as usual. A new departure has been made in this branch by the Water Works

during the year, namely, the manufacture of composition service cocks by the department. A Fox lathe was procured for this work in 1896, but having a large number of cocks in stock, nothing was done until this year when a competent brass worker was employed, tools and patterns made and the work begun. As to the wisdom and economy of this step, anybody who looks into the matter will agree. A careful estimate show that cocks are made for less money than they cost when purchased, and are much better in material and workmanship. The need of having a mechanic capable of doing this kind of work can be understood when the amount of work is taken into consideration. Over 2,000 cocks with connections are used every year, besides the countless number of repairs being made every year on hydrants, gates, fountains and pumps.

### NEW SERVICES.

152	5-8-inch Lead Pipe . . . .	5,081 feet
183	3-4-inch Lead Pipe . . . .	6,146 feet
8	1-inch Lead Pipe . . . .	355 feet
1	1-inch Iron Lead Lined . . . .	97 feet
3	3-4-inch Iron Lead Lined . . . .	205 feet
2	2-inch Iron Lead Lined . . . .	347 feet
1	1½-inch Iron Pipe . . . .	99 feet
<hr/>		<hr/>
350	Total laid in 1897 . . . .	12,330 feet
	Amount previously laid . . . .	386,902 feet
	Total now laid . . . .	399,232 feet
	Total services laid . . . .	10,894
	Total cut off at main . . . .	686
	Total reconnected . . . .	45
	Total now in use . . . .	10,253

REPORT OF THE SUPERINTENDENT.  
SERVICES CHANGED.

No.	Kind.	CHANGED TO						Total feet
		Lead. ¾-in.	Lead ¾-in.	Lead 1-in.	Lead Lined 2-in.	Lead Lined ¾-in.	Lead Lined 1-in.	
151	¾-in. iron.....	4,563	....	....	....	....	....	4563
55	¾-in. iron.....	....	1,955	....	....	....	...	1955
3	1½-in iron... ..	....	....	61	....	..	....	61
9	¾-in. iron.....	....	....	296	....	....	....	296
1	¾-in. lead.....	. .	....	48	....	. .	....	48
1	1-in. lead.....	....	....	....	61	....	....	61
1	1-in. iron. ....	....	....	....	55	....	....	55
1	¾-in. lead.....	26	....	....	....	....	....	26
1	¾-in. iron... .	....	....	....	....	29	....	29
1	1-in. iron.. ....	25	....	....	....	....	....	25
1	2-in. iron.....	....	....	20	....	....	....	20
1	2-in. iron.....	....	....	....	4	....	....	4
2	¾-in. iron.....	....	. .	....	....	....	114	114
2	1-in. iron.....	....	....	60	...	....	....	60
230	Total.	4,614	955	485	120	20	114	7308

METERS.

New Meters . . . .	676
Meters condemned . .	41
Meters cleaned and repaired.	642
Meters frozen and burst .	10
Meters discontinued . .	46
Meters set for private use .	16
New meters set in place of old ones condemned .	43

**METERS RUNNING January 1, 1898.**

Size.	$\frac{5}{8}$ -in.	$\frac{3}{4}$ -in.	1-in.	1 $\frac{1}{2}$ -in.	2-in.	3-in.	4-in.	6-in.	Total.
Desper.....	77	34	10	....	..	....	....	....	121
Crown.....	1760	1439	255	11	13	2	5	2	3487
Worthington....	225	29	51	65	32	7	3	....	412
Duplex... ..	7	12	7	....	....	....	....	....	26
Ball & Flitts.....	2	....	....	...	....	....	..	....	2
Flitts Rotary.....	1	1	....	....	....	....	....	....	2
Frost.....	6	6	1	....	....	...	....	....	13
Thomson.....	6	19	3	....	....	....	....	....	28
Gem.....	...	....	....	....	5	....	2	1	8
Metropolitan....	....	2	....	....	...	....	....	....	2
Trident .....	43	17	1	....	....	....	....	....	61
Nash .....	61	33	1	....	....	....	....	....	95
Lambert .....	20	4	....	....	....	....	....	....	24
Niagara .....	....	1	....	...	....	....	....	....	1
Hersey.....	51	30	3	....	....	....	....	....	84
Empire.....	8	11	....	....	....	....	....	....	19
Westinghouse ..	....	1	....	....	....	...	....	....	1
Columbia.....	2	....	....	....	....	....	...	....	2
Union.....	....	....	....	1	....	....	....	...	1
<b>Total</b>	<b>2269</b>	<b>1639</b>	<b>332</b>	<b>77</b>	<b>50</b>	<b>9</b>	<b>10</b>	<b>3</b>	<b>4389</b>

## PRIVATE METERS RUNNING. January 1, 1898.

Size.....	$\frac{1}{4}$ -in.	$\frac{1}{2}$ -in.	$\frac{3}{4}$ -in.	1-in.	2-in.	Total.
Desper.....	....	1	3	1	....	5
Worthington.....	....	....	....	1	2	3
Crown.....	1	28	22	2	....	53
Duplex... ..	....	1	....	....	....	1
Thomson .....	....	....	1	....	....	1
Hersey .....	....	2	....	....	....	2
Nash.....	....	9	1	....	1	11
Frost .. ..	....	2	1	....	....	3
Empire.....	....	1	....	....	....	1
Trident.....	....	1	....	....	....	1
Total.	1	45	28	4	3	81

## PIPE YARD.

About an acre of land owned by the Department and situated close to the tracks of the N. Y., N. H. & H. R. R. Co. has been selected for a new pipe yard. This land is not available for anything else, and on account of the tracks will afford excellent facilities for handling heavy cast iron pipe.

The yard now in use is much too small, besides costing the Department three hundred dollars a year.

A road was built to the new yard last fall, the brook is spanned by a stout bridge constructed with a view of carrying coal in cars across it for use at Pumping Station No. 2, which is near by, provided it would be deemed best to lay a spur track that far.

## MISCELLANEOUS.

When the complaints from people on the High Service were loudest, it was thought best to make sure and not let any water from the High Service Reservoir into the mains by shutting it off completely ; this was done by placing a re-

lief valve on High Service force main in Pumping Station No. 1 and closing the 12-inch gate of the reservoir pipe at the reservoir. However, water could not get in or out and to provide for an emergency such as a pump breaking, etc., a by pass was put around this 12-inch gate with a check valve opening from the reservoir. In that case a drop in the pressure would allow the check to open and the needed water drawn. This plan worked perfectly; not a word of complaint was heard after that, and the pump being run against eight pounds more pressure, the service was improved so that the highest building on the High Service got water in the upper stories.

The outside fence at the Beacon Street reservoir was given two coats of red paint during the summer.

### CONCLUSION.

In concluding I take the opportunity of returning thanks to the President and members of the Water Board and to J. W. Crawford, Clerk of the Board, for kind and hearty co-operation.

Respectfully submitted,

ROBERT J. THOMAS,

*Superintendent.*

## LOW SERVICE.—WATER PIPES LAID IN 1897.

STREETS.	BETWEEN WHAT STREETS.	Length in feet.					Total.
		4-in.	6-in.	8-in.	10-in.	12-in.	
A.....	Extended westerly to Wilder.....		278				278.0
Aiken Ave....	Ludlam and Cumberland Road...		331				331.0
Aiken Ave....	Northerly to Dalton.....		266				266.0
Avon.....	Northerly from Seventh Ave.....		111				111.0
Avon.....	Extended southerly.....		132				132.0
Avon.....	Southerly to Fourth Ave.....		67				67.0
Auburn,.....	Westerly to Gorham.....		96½				96.5
Baldwin.....	Extended southerly.....		122				122.0
Blodgett.....	Southerly to Forrest.....		42				42.0
Boulev'd Wells	On blow-off.....					97½	97.5
Broadway ....	Worthen and Dummer .....			266			266.0
Broadway ....	Westerly to Pawtucket.....		143				143.0
Broadway ....	Fire Service to Am. Card Clo. Co..	48½					48.5
Broadway ....	Fire Service to Normal School ...	168					168.0
Brookside.....	Extended northerly.....		247				247.0
Canton.....	Southerly towards Princeton.....		210				210.0
Chambers.. ...	Westerly to Gorham.....		84				84.0
Chippewa.....	Saratoga and Seneca.....		97				97.0
City Stables...	Fire Service off Lagrange.....		27				27.0
City Stables...	Fire Service off Broadway.....		161				161.0
Coburn Ave...	Extended westerly.....		376				376.0
Columbus Ave.	Easterly to Wakler ....		126				126.0
Corbett.....	Extended easterly.....		14				14.0
Crawford.....	Extended northerly.....		156				156.0
Crawford .....	Extended southerly....		120				120.0
Crawford.....	Southerly from Seventh Ave.....		83				83.0
Cumberl'nd Rd	Southerly to Ennell..		52				52.0
Dalton... ..	Exeter and Hovey... ..		174				174.0
Dartmouth ...	N'th'ly and s'th'ly from Princeton			50			50.0
Doane.....	Extended southerly..		54				54.0
	Carried forward. ....	216½	3569½	316		97½	4199.5

LOW SERVICE.—WATER PIPES LAID IN 1897.—*Continued.*

STREETS.	BETWEEN WHAT STREETS.	Length in feet.					Total.
		4-in.	6-in.	8-in.	10-in.	12-in.	
	<i>Brought forward</i> .....	216½	3569½	316		97½	4199.5
Dunbar.....	Southerly from Varnum Ave. . . .		184				184.0
Dunphy.....	Extended northerly.....		48				48.0
E. ....	Extended westerly.....		88				88.0
Ennell .....	Easterly to Hildreth.....			590½			590.5
Farmland Rd..	Westerly to Lakeview Ave.....		345				345.0
Fifth Ave.. .	Easterly from Crawford.....		108				108.0
Fourth Ave....	Easterly from Avon.....			164			164.0
Forrest.....	Easterly to Blodgett.....		42				42.0
Foster.....	N'th'ly and s'th'ly from Princeton		62				62.0
Fowler Road..	Westerly from Varnum Ave.....		1384	48			1432.0
Griffin .....	Agawam and Andrews.....		270½				270.5
Grove.....	Extended easterly.....		39				39.0
Hawthorne....	Southerly from Pine.....		144				144.0
Hovey.....	Easterly to Dalton... ..		153				153.0
Ina... ..	Extended northerly.....		48				48.0
June.....	Northerly from Twelfth St.....		72				72.0
Lang .....	Northerly from Midland.....		185				185.0
Livingston Ave	Northerly to Middlesex.....			730			730.0
Ludlam ... ..	Easterly to Cumberland Road....		136				136.0
McKinley Ave.	Westerly from Stevens.....		244				244.0
Mead.....	Easterly to Whipple... ..		160				160.0
Midland .....	Easterly from Blodgett.....		96				96.0
Moody. ....	Tremont and Tilden.....		203½				203.5
Moody.....	Extended northerly.. ..				604		604.0
Moody.....	Riverside and Colonnial Ave.....					684	684.0
Mt. Hope .....	Northerly to Seventh Ave. ....		130				130.0
New 1st.....	Southerly from Princeton.. ..		37				37.0
New 2nd. ....	Southerly from Princeton.....		37				37.0
Orford .....	Riverside and Second Ave.....		423				423.0
	<i>Carried forward</i> .....	216½	8658½	1848½	604	781½	12,109.0



LOW SERVICE.—WATER PIPES LAID IN 1897.—*Continued.*

STREETS.	BETWEEN WHAT STREETS.	Length in feet.					Total.
		4-in.	6-in.	8-in.	10-in.	12-in.	
	<i>Brought forward</i> .....	216½	8658½	1848½	604	781½	12,109.0
Orleans.....	Extended easterly. ....		210				210.0
Pawtucket ...	Northerly from Broadway. . . . .			442			442.0
Pawtucket....	On blow-off.....		49				49.0
Pollard.....	Easterly to Chapel.....		138				138.0
Pratt.....	N'th'ly and s'th'ly from Princeton		165				165.0
Princeton.....	Wilder and Baldwin....				3192½	1637½	4830.0
Princeton.....	On blow-off. ....		21½				21.5
Princeton.....	Extended westerly.....				320		320.0
Quebec.....	Extended southerly.....		381½				381.5
Rogers .....	Knapp Ave. southerly.....				890		890.0
Saratoga.. ...	Easterly from Chippewa.....		120				120.0
Seneca .....	Easterly from Chippewa.....		115				115.0
Seventh Ave..	Mt. Hope and Avon..		210				210.0
Seventh Ave..	Avon and Crawford.....		230				230.0
Shaw.. .....	Easterly to School.....		148				148.0
Shaw. ....	Westerly to South Loring.....		112				112.0
Sixth Ave.....	Easterly from Mammoth Road. ..		216½				216.5
Sixth Ave.....	Extended easterly.....		48				48.0
South.. .....	Fire service St. Peter's Church....	54½					54.5
South Canton..	Northerly to Princeton .....		175				175.0
Starbird .....	Southerly from Woodward Ave...		93				93.0
State .....	Southerly from Moore.....		540				540.0
Sterling Mills..	Fire service new storehouse.....		24				24.0
Stewart.....	Extended southerly.....		84				84.0
Thomas.....	Southerly from Broadway.....		399				399.0
Thorndike ....	12" pipe laid on Fletcher St. bridge					180	180.0
Varnum.....	Easterly to Seventh Ave.....		205				205.0
Wannalancit..	Fire service Bartlett School.....	45					45.0
Ward.....	Northerly to Perkins..		64				64.0
	<i>Carried forward.</i> .....	316	12,407	2290½	5006½	2599	12,619.0

LOW SERVICE.—WATER PIPES LAID IN 1897.—*Continued.*

STREETS.	BETWEEN WHAT STREETS.	Length in feet.					Total.
		4 in.	6 in.	8 in.	10 in.	12 in.	
	<i>Brought forward</i> .....	316	12,407	2290½	5006½	2509	12,619.0
Warren .....	Fire service Am. House block....		25				25.0
Warwick .....	Northerly from B St. ....		125				125.0
West .....	Easterly to Coburn .....		146				146.0
Westford .....	Extended westerly .....			364			364.0
Whitney Ave..	Extended westerly .....		24				24.0
Wiggin .....	Extended westerly .....		129				129.0
Wilder .....	Westford and Princeton.....					424½	424.5
Woodward Av.	Extended westerly. ....		48				48.0
Worthen .....	Fire service Associate building...		23½				23.5
Hydrants.....	.....		175				175.0
	Laid in 1897.....	316	13,102½	2654½	5006½	3023½	24,103.0
	Less taken out Wilder. Princeton, Lincoln Sq., Thorndike, Fletcher and June Sts.....						1823.0
	Total.....						22,280.0

HIGH SERVICE.—WATER PIPES LAID IN 1897.

STREETS.	BETWEEN WHAT STREETS.	Length in feet.					Total.
		4-in.	6-in.	8-in.	10-in.	12-in.	
Fairview .....	Easterly to Belmont Ave.....		161				161.0
Mt. Pleasant..	Check valve connect'n at Reserv'r					32	32.0
WentworthAv.	Extended northerly.....		105				105.0
	Laid in 1897.....		266			32	298.0
	High service laid previous to 1897.						35,215.0
	Total high service to Jan 1, 1898..						35,513.0

Brought forward.....	22,281 0
Low service laid previous to 1897.....	588,216.8
Total low service to Jan. 1, 1898.....	610,497.8
Total high service to Jan. 1, 1898.....	35,513.0
Total high and low service to Jan. 1, 1898.....	646,010.8
Total in miles, 122.33.	

## LOW SERVICE—LIST OF STOP GATES SET DURING 1897.

STREETS.	LO
A.....	12½ ft. south of north Wilder Street.....
Anburn.....	11 ft. south of north Gorham Street....
Baldwin ....	13½ ft. west of east line line Princeton Street
Bleachery.....	On connection between service. ....
Blodgett.....	12 ft. east of west line Forrest Street.....
Boulevard Wells ...	On 12" blow-off near
Boulevard Wells ..	On delivery pipe near
Branch....	15½ ft. south of north line line Coral Street. ..
Broadway .....	On fire service to City line Broadway, 12 ft
Broadway .....	18.3 ft. south of north Worthen Street ....
Broadway .....	13 feet south of north tucket Street.....
Broadway .....	On fire service to Stat Broadway .....
Broadway .....	14.6 ft. south of north vice to Am. Card Cl
Chambers. ....	11 ft. south of north line Gorham Street.....
Columbus Ave.....	12 ft. south of north line line Walker Street.
Coral. . ....	21 ft. west of east line line Branch Street.
Cumberland Road..	12½ ft. east of west north line Ennell S.
Cumberland Road..	11.3 ft. east of West south side Ludlam
Dalton.....	12 ft. west of east line Hovey Street ...
Dunbar. . ....	12 ft. west of east line Varnum Ave ....
Ennell. . ....	13 ft. north of south line line Hildreth Street
Farmland Road. ...	12 ft. north of south line line Lakeview Ave
Fort Hill Ave. ....	14.7 ft. east of west line of north line Sherman Street. ....

LOW SERVICE—LIST OF STOP GATES SET DURING 1897—*Continued.*

LOW SERVICE—LIST OF STOP GATES SET DURING 1897—*Continued.*

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# LOW SERVICE—LIST OF HYDRANTS SET DURING THE YEAR 1897.

STREETS.	LOCATION.
Bleachery .....	Easterly side, at Bleachery Co.'s mill yard.
Bleachery .....	Easterly side, at Bleachery Co.'s mill yard.
City Stables.....	In yard, opp. B. S. S. (Private).
Coburn Ave.....	Northerly side, on terminus.
Concord .....	Westerly side, opp. No. 227.
Corbett.....	Southerly side, on terminus.
Doane.....	Northerly side, on terminus.
Ennell.....	Southerly side, opp. Cumberland Road.
Farmland Road.....	Southerly side, 4 ft. east Lakeview Ave.
Forrest .....	Northerly side, 142 ft. west from Blodgett.
Fort Hill Ave.....	Easterly side, 3½ ft. north of Porter Street.
Fort Hill Ave.....	Westerly side, front of No. 31-33.
Fowler Road.....	Northerly side, on terminus.
Grove.....	Northerly side, 1½ ft. east of Manahan Street.
Hale.....	Northerly side, 7 ft. east of Lincoln Square. (Changed).
Hovey .....	Southerly side, 3 ft. west of Dalton Street.
Hutchinson.....	Easterly side, on terminus.
Ina .....	Easterly side, on terminus.
Lundberg.....	Southerly side, opp. O'Connell Street.
Moody.....	Westerly side, 10 ft. south Fifth Ave.
Nelson .....	Easterly side, on terminus.
Perkins.....	Southerly side, changed from Ward Street.
Plain. . . . .	Southerly side, 7 ft. west of Quimby Ave.
Pratt .....	Westerly side, 7 ft. south of Princeton Street.
Quebec.....	Easterly side, on terminus.
Riverside.....	Westerly side, 5½ ft. north of Moody Street.
Rogers .....	Easterly side, south of Haines Street.
Seventh Ave.....	Southerly side, 11 ft west of Avon Street.
Starbird .....	Westerly side, 4 ft. south Woodward Ave.
State .....	Westerly side, on terminus.
Varnum .....	Northerly side, 190 ft. east from Seventh Street.
Varnum Ave . . .	Northerly side, opp. Dunbar Street.
Westford.....	Northerly side, on terminus.
Wiggin.....	Northerly side, on terminus.

# HIGH SERVICE.—LIST OF STOP GATES SET DURING THE YEAR 1897.

## HIGH SERVICE.—LIST OF HYDRANTS SET DURING THE YEAR 1897.

STREET.	LOCATION.
Wentworth Ave. ....	Easterly side, on terminus.

## STOCK ON HAND JAN. 1, 1898.

## GATES.

SIZE.	4-in.	6-in.	8-in.	10-in.	12-in.	16-in.	20-in.	24-in.
	4	12	12	..	..	.	..	.



pipe hangers for East Merrimack street bridge, 900 lbs. old brass, 2 sand screens, 2 gravel screens, 1 shaft hanger, 2 sets of caulking tools, 1 3-inch flange valve, 9 striking hammers, 10 caulking hammers, 9 cold chisels, 1 railroad jack, 1 set blocks and rope, 1 crosscut saw, 3 Edson marine pumps, 12 lengths suction hose, 20 pairs rubber boots, 4 tapping machines and rubbers, 6 taps and drills, 3 tap wrenches, 1 set plumbers' tools, 2 naphtha furnaces, 1 tin tunnel, 1 dark lantern, 2 2-inch chisels, 1 hatchet, 3 brass hand pumps, 4 hand saws, 1 piece steel for ratchet, 100-ft. black tin tubing, 50-ft. black tin rod, 3 screw drivers, 9 files, 2 dust pans, 4 oil cans, 1 large oil can, 2 hydrant reducers for hose, 1 Norton door check, 1 machine for testing meters, 1 chain, 1 set of bits, 1 set of chisels, 1 pair pliers, 1 pair round nose pliers, 2 soldering irons, 1 belt punch, 1 set steel figures, 1 naphtha can, 2 hack saws, 1 pair scissors, 1 pair snips, 1 saw set, 3 desks, 1 small book case, 15 lbs. iron washers, 35 bolts, 2 gate plans, 1 750-gallon tank for testing meters, 1 marlin spike, 2 naphtha lamps, 1 L. W. W. seal, 1 set of tools for sealing fire services, 2 tool bags, 1 step ladder, 1 clock, 1 map of water mains, 2 chairs, 3 stools, 2 floor brushes, 1 mirror, 1 can of glue, 1 waste can, 1 lawn mower, 2 steel squares, 1 piper's bench, 2 lead furnaces, 6 lengths of 2½-inch hose, 1 nozzle, 2 dutchmen, 5 lbs. iron wire, 6 lbs. brass rod, 20 lbs. copper wire, 2 2-inch steam valves, 1 paint brush, 11 pails, 20 exploders, 44 tools for brass lathe, 12 sets; 13 cast iron chucks, 1 set hand chasers, 1 set hand tools, 1 set broaches, 25 tools for brass work, 12 patterns.

#### PROPERTY AT SUPERINTENDENT'S OFFICE.

Two desks, 3 chairs, 1 set of drawers and book case, 1 letter press and stand, 1 Howard electric clock, 1 gate plan, 2 diagrams, 1 picture, 15 notices, 4 bill files, 2 inkstands, 1 water gauge, 1 feather duster.

#### PROPERTY AND TOOLS AT TOOL HOUSE.

55 picks, 48 round point shovels, 45 pick handles, 22 mauls, 5 driving mauls, 3 lead pots, 4 sets derrick falls, 4 chains, 4 striking hammers, 2 spoon shovels, 3 tunnelling bars, 33 s. w. wrenches, 14 wrenches for hydrants and gates, 6 square pointed shovels, 10 hoes, 3 grub hoes, 1 scythe, 3 paving hammers, 2 hand saws, 2 caulking hammers, 2 claw hammers, 2 iron rakes, 1 stone hammer, 5 ladles, 1 axe, 2 bucksaws, 2 lines, 1 screw jack, 1 sledge hammer, 14 crowbars, 8 wedges, 3 derricks, 9 wheelbarrows, 3 saw horses, 1 sand sifter, 1 gravel sifter, 4 tool boxes, 3 sets iron falls, 1 portable forge,

75 ft.  $1\frac{3}{4}$ -inch rope, 4 paving mauls, 1 boat, 7 sling ropes, 9 tag ropes, 36 lanterns, 2 pails, 2 stone chains, 20 gallons kerosene, 200 ft.  $\frac{3}{4}$ -inch iron cable, 2 iron hoops, 1 long handle dipper, 8 wooden plugs, 1 harness tray, 169 ft. 4 inches of  $1\frac{1}{4}$ -inch steel drills, 24 ft. of 1-inch steel drills, 9 spoons.

#### PROPERTY AND TOOLS AT PUMPING STATION No. 1.

11 wrenches for high duty Worthington, 11 wrenches for low duty Worthington, 11 wrenches for Morris engine, 2 oil dishes, 1 set oil cans, 1 oil filter, 1 work bench, 1 vise, 10 drills, 2 cold chisels, 2 bitstocks, 2 bits, 1 level, 1 keyhole saw, 1 hack saw, 3 monkey wrenches, 3 sledge hammers, 1 copper hammer, 2 hammers, 4 socket wrenches, 1 2-foot steel square, 2 jack screws, 1 tool cupboard, 1 set differential blocks, 1 pair gas pliers, 1 set fire irons, 1 brass hydrant, 2 platform scales, 1 hay scales, 2 step ladders, 5 ladders, 2 lanterns, 2 lawn mowers, 1 barometer, 3 thermometers, 2 iron wheelbarrows, 2 iron pails, 2 indicators, 3 steam guages, 12 guage glasses, 48 cakes of soap, 3 brooms, 50 lbs. tallow, 1 gas lamp with tubing, 1 24-inch elbow, 6 grate sections with bars, 1 10-inch valve, 2 clocks, 1 book-case, 1 bed, 3 chairs, 1 table, 1 desk, 2 floor brushes, 2 mops, 1 dust pan, 4 Stillson wrenches, 5 cuspidors, 1 extra check valve for high duty Worthington, 1 set drawings high duty Worthington, 1 ratchet, 6 pairs pipe tongs, 4 pipe dies, 1 flue scraper, 1 oil cupboard, 45 gallons cylinder oil, 30 gallons machine oil, 6 10-inch rubber valves, 10 5-inch rubber valves, 15 lbs. Italian flax, 100 ft. felting, 10 lbs. cotton waste, 23 lbs. Garlock packing, 5 lbs. asbestos packing, 5 lbs. square tuck packing, 70 lbs. Knowlton packing, 4 lbs. Chesterton packing, 90 springs for high duty Worthington.

#### PROPERTY AND TOOLS AT PUMPING STATION No. 2.

One work bench, 1 vise, 1 bitstock, 1 set of bits, 1 clock, 1 thermometer, 7 cold chisels, 4 monkey wrenches, 10 socket wrenches, 14 wrenches, 2 pinch bars, 2 gate wrenches, 3 steel drills, 1  $1\frac{1}{2}$ -inch pipe tongs, 1 1-inch pipe tongs, 1 sledge hammer, 1 coal hammer, 2 long steel chisels, 4 taps, 1 axe, 2 ice chisels, 2 long handle shovels, 1 grapple rake, 1 wire rake, 1 hand hole gasket, 1 slice bar, 1 boiler hoe, 2 iron wheelbarrows, 4 lamps, 1 platform scales, 1 30-ft. Howe platform scales, 200 ft. cotton hose, 2 brooms, 1 map of Lowell, 3 Stillson wrenches, 1 gallon measure, 45 lbs. waste, 35 gallons spindle oil, 1 tunnel, 12 lbs. hemp packing, 2 oil cans, 1 glass pitcher, 4

glasses, 110 rubber valves, 15 spindles for Deane pump, 35 valve plates, 35 springs, 1 desk, 2 chairs, 1 grindstone, 27 sheets of emery paper, 2 files, 1 copper hammer, 2 ladders, 1 step ladder, 1 iron pail, 1 map, 25 ft. 1-inch hose, 2 picks, 2 shovels, 1 2-inch die plate and dies, 1 1-inch die plate and dies, 6 gallons valvoline oil, 2 2-inch pipe cutters, 1 6-inch pipe cutter, 2 caulking hammers, 1 5-gallon oil can, 1 box piston packing,  $\frac{1}{4}$  barrel soda ash, 15 glass gauges, 2 rings for water piston, 1 ratchet drill, 2  $\frac{3}{4}$ -inch taps, 3 strainers, 6  $1\frac{1}{2}$ -inch iron nuts, 1 vise, 1 sickle, 1 brush, 9 boxes ring packing, 1 well wrench, 6 6-inch couplings, 1 hydrant wrench, 38 6-inch sleeves, 13 flange tees, 4 long iron gate boxes, 7 bridge bolts, 1500 bricks, 2 fire shovels, 1 stool, 40 gallons kerosene, 2 60-gallon oil tanks.

#### PROPERTY AND TOOLS AT PUMPING STATION No. 3.

Five wrenches for Worthington pump, 1 18-inch monkey wrench, 1 12-inch monkey wrench, 1 8-inch monkey wrench, 2 Stillson wrenches, 4 guard wrenches, 3 offset wrenches, 8 socket wrenches, 2  $\frac{3}{4}$ -inch iron bolts, 3  $\frac{1}{2}$ -inch iron bolts, 12 gallons cylinder oil, 1 gallon spindle oil,  $\frac{1}{2}$  box metal polish,  $\frac{1}{2}$  box  $\frac{5}{8}$ -inch square flax packing, 1 tunnel, 1 saw, 1 clock, 1 dust pan, 1 brush, 1 broom, 1 2-inch well scraper, 1 brass tray, 3 pairs rubber boots, 3 6-inch valve studs, 6 6-inch rubber valves, 24 4-inch springs, 1 box  $\frac{5}{8}$ -inch Eureka packing, 20 ft. fibrous packing, 15 lamp wicks, 2 lantern wicks, 1 step ladder, 1 8-ft. ladder, 1 stand, 1 9-ft. running board, 20 ft.  $1\frac{1}{4}$ -inch hose, 1 bench, 30 ft.  $\frac{3}{4}$ -inch rubber hose, 1 platform scales, 1 iron wheelbarrow, 2 coal shovels, 1 sledge hammer, 1 broom, 2 slice bars, 2 boiler hoes, 1 hook bar, 6 gate bars, 1 bearing bar, 1 pail fire clay, 1 pail, 6 drip pans, 6 brass oil cans and tray, 1 2-quart can, 2 gate wrenches, 3 chairs, 2 dippers, 1 lantern, 3 B. & H. lamps, 2 large lamps, 1 bracket lamp, 1 shade lamp, 2 60-gal. oil tanks, 12 gals. kerosene, 1 waste can, 40 lbs. waste, 1 10-gal. can, 1 5-gal. can, 1 iron rake, 1 mop, 1 hoe, 1 24-inch flange, 2 shovels, 1 pick, 2 lamp chimneys, 10 B. & H. lamp chimneys, 1 strainer, 1 2-inch scraper, 1 faucet, 2  $\frac{5}{8}$ -inch stud bolts, 1 1-inch Jenkins valve disk, 21 lbs. hemp, 1 desk, 18 ft. 8-inch pipe, 44 ft. 6-inch pipe, 6 ft. 5-inch pipe, 1 5-inch elbow, 1 6-inch elbow, 2 6-inch  $\frac{1}{8}$  turns, 3 6-inch couplings, 25 ft. 2-inch pipe, 1 6-inch flange, 1 5-inch flange, 20 ft. 1-inch pipe, 2 screens, 2 paint brushes, 1 wooden wheelbarrow, 1 6-inch jack screw, 3 hand hole gaskets, 15 ft. 6-inch wrought iron pipe, 1 box  $\frac{3}{4}$ -inch Eureka packing, 90 ft. 3-inch iron pipe, 40 ft. 2-inch pipe, 30 ft.  $1\frac{1}{2}$ -inch pipe, 84 ft. 6-inch pipe, 1 well sinker.

## PROPERTY AND TOOLS AT PUMPING STATION No. 4.

One desk, 3 chairs, 2 clocks, 3 small lamps, 4 large lamps, 5 lanterns, 2 brooms, 2 brushes, 1 whisk-broom, 1 mirror, 5 pails, 2 letter files, 1 24-inch monkey wrench, 1 12-inch monkey wrench, 2 6-inch monkey wrenches, 2 step ladders, 4 S. wrenches, 18-inch Stillson wrench, 1 oil stand, 3 oil cans, 16 square wrenches, 10 iron hooks, 7 socket wrenches, 1 inkstand, 4 small lamp chimneys, 5 gauge glasses, 14 lamp wicks, 20 ft.  $\frac{1}{4}$ -inch Jenkins packing, 10 valve springs, 1 saw, 1 hatchet, 1 anvil, 1 cold chisel, 1 boat (complete), 1 ground hoe, 10 gals. black enamel, 35 gals. cylinder oil, 5 gals. machine oil, 30 gals. kerosene, 2 60-gal. oils tanks, 1 oil stand, 1 dust pan, 5 drinking glasses, 1 pipe cutter, 1 screw driver, 1 plane, 1 whetstone, 1 pair 1-inch pipe tongs, 1 pair  $\frac{3}{4}$ -inch pipe tongs, 1 pair 2-inch pipe tongs, 2 pairs blacksmith tongs, 1 trowel, 1 whitewash brush, 50 ft. of  $\frac{3}{4}$ -inch rubber hose, 3 coal shovels, 1 long handle shovel, 1 slice bar, 2 gamble rakes, 2 fire hoes, 1 poker, 1 sledge hammer, 1 iron rake, 1 vise, 1 bench, 1 blow-out hose, 1 platform scales, 2 pumps, 1 dipper, 1 tube scraper, 2  $\frac{1}{2}$ -inch dies, 2  $\frac{3}{4}$ -inch dies, 1 1-inch die, 1  $1\frac{1}{2}$ -inch die, 1 hammer.

## PROPERTY AT STABLE.

Seven horses, 8 single harnesses, 1 set double harness, 8 street blankets, 2 democrat wagons, 1 Goddard buggy, 7 sleighs, 5 wagons, 1 single truck, 1 double truck, 7 stable blankets, 2 brooms, 6 brushes, 6 curry combs, 6 pitchforks, 7 rubber horse covers, 1 string of bells, 1 chamois skin, 1 box harness soap, 5 sponges, 1 wagon jack, 1 hay cutter, 2 feed boxes, 1 sprinkling can, 6 whips, 3 tons hay, 100 bushels of oats, 2 bales straw,  $\frac{1}{2}$  bbl. Standard Food, 2 bags shorts, 3 lap robes, 1 wolf skin robe, 15 lbs. grease, 2 pails, 1 can harness oil, 1 large sun shade, 2 wagon covers, 20 ft. 1-inch rubber hose, 1 bench, 1 cupboard.

## PROPERTY AND TOOLS AT BLACKSMITH SHOP.

One forge and bellows, 3 anvils, 1 saw, 1 sledge hammer, 1 striking hammer, 2 blacksmith hammers, 1 caulking hammer, 1 steel square, 4 cutters, 3 handle punches, 4 hand punches, 32 blacksmith tools, 1 gate wrench, 2 wrenches, 16 pairs tongs, 1 pair calipers, 1 hydrant wrench, 1 work bench, 1 vise, 1 draw knife, 2 L. W. W. stamps, 1 file, 8 levers, 1 coal hod, 1 portable forge, 600 lbs. old iron, 40 lbs. pick steel, 20 lbs. machine steel, 30 lbs. Norway iron, 1 closet, 75 iron nuts, 1 coal shovel, 1 ton coal.

**PROPERTY AT RESERVOIR.—(LOW SERVICE).**

One boat, 2 lawn mowers, 1 scythe, 1 snath, 1 wooden rake, 1 vine rake, 1 long handle shovel, 1 crow bar, 1 monkey wrench, 1 scuff hoe, 1 long handle hoe, 1 wooden shovel, 1 axe, 1 ice chisel, 1 lantern, 1 wheelbarrow.

**PROPERTY AND TOOLS AT INLET HOUSE.**

Nine shovels, 1 gate wrench, 1 pick, 1 dip net, 1 ice hook.

**GALLERY HOUSE.**—16 screens, 1 shovel, 1 boat (complete), 2 iron falls, 2 tag ropes, 1 gate wrench, 1 fork wrench, 1 T wrench, 25 ft. 1-inch rubber hose.

**BODWELL GATE HOUSE.**—1 gate wrench, 1 pick.

**MOVABLE FIXTURES AND PROPERTY AT OFFICE, CITY HALL.**

Two roll-top desks, 2 standing desks, 1 double flat desk, 1 3-place inspector's desk, 1 2-place inspector's desk, 2 single inspector's desks, 2 heavy oak tables, 1 typewriter desk, 1 Remington typewriter, 1 small table, 1 vault table, 2 swivel upholstered chairs, 6 upholstered chairs, 12 cane seated armchairs, 8 swivel cane seated chairs, 2 high chairs, 2 stools, 1 step chair, 1 settee, 1 bookcase, 1 water tank, 2 water-pressure gauges, 2 thermometers, 1 clock, 2 table gas lamps, 33 framed pictures—plans, etc.; 2 floor rugs, 1 rubber mat, 1 set street tools, 2 earthen spittoons, 6 brass spittoons, 6 waste paper baskets, 1 shovel (historic), 2 mirrors, 1 letter copying press, 2 umbrella racks, 20 inkstands, 2 pen racks, 1 gas stove, 4 book racks, set tools (hammer, wrench, 2 screwdrivers, wire cutter, 1 plane, 1 saw, 1 chisel), 3 tumblers, boot-blackening outfit, 1 hair brush, 1 clothes brush, 1 match chest, 1 fire-insurance map of Lowell, 1 atlas city of Lowell, 5 tin yearly boxes, 1 set Massachusetts statutes, 1 large dictionary, 1 large photo. album, 1 revolving book case, 1 card index case.

# REPORT OF THE CITY ENGINEER.

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OFFICE OF CITY ENGINEER,

Lowell, Mass., January 1, 1898.

TO THE LOWELL WATER BOARD,

*Gentlemen:*—I have the honor to submit the Twenty-fifth annual report for the year ending December 31st, 1897, as follows:

## PUMPAGE.

The pumpage for the year is 132,891,435 gallons less than that of last year; a decrease doubtless due to the mild weather of the winter of 1896-7, the unusually large rainfall during the past summer and the increase in the use of meters by water takers.

The greatest quantity pumped in one day was 9,753,342 gallons, on February 14th.

The greatest quantity pumped in one week was 62,432,263 gallons, an average of 8,918,895 gallons per day, which was pumped during the week of February 8th-14th.

The pumpage into the high service reservoir shows an increase of 8,205,288 gallons over last year.

The cost of pumping water into the low service reservoir was sixteen dollars and forty-eight cents (\$16.48) per million gallons, which, added to the cost of pumping from the low service reservoir into the high service reservoir, makes the total cost of high service pumpage twenty-six dollars and eighty-six cents (\$26.86) per million gallons.

The following table shows source of supply, quantity pumped, and cost per million gallons, at the several pumping stations during the year 1897.

TABLE SHOWING SOURCE OF SUPPLY, QUANTITY PUMPED AND COST AT THE SEVERAL STATIONS DURING THE YEAR 1897.

PUMPING STATIONS.	SOURCE OF SUPPLY—WELL WATER.				Total in U. S. Gallons.	COST.	
	100 Driven Wells at Pawtucket Boulevard and Filter Gallery.	90 Driven Wells at City Farm.	130 Driven Wells at Chelmsford, Mass.	Distributing Mains of Low Service System.		Total.	Per Million Gallons.
No. 1 (W. Sixth St.)— Low Service.....	1,352,724,180	.....	... ..	.....	1,352,724,180	\$10,819 17	\$ 8 02
High Service.....	.....	.....	.....	45,082,716	45,082,716	468 13	10 38
No. 2 (Cook Wells).....	.....	541,704,942	.....	.....	541,704,942	8,740 93	16 14
No. 3 (Hydraulic Wells).....	.....	.....	511,811,330	.....	511,811,330	7,955 10	15 54
No. 4 (Boulevard Wells).....	1,186,744,158	.....	.....	.....	1,186,744,158	12,111 08	10 21
Total Pumpage.....	.....	.....	.....	.....	3,638,067,326		
Deduct quantity pumped twice —Pumped at Station 4 and repumped at Station 1.....	....	.....	.....	1,186,744,158			
Repumped by High Service..	.....	.....	.....	45,082,716	1,231,826,874		
Net Pumpage.....	.....	.....	.....	.....	2,406,240,452	\$40,124 41	\$16 68



The following tables showing the performance of the engines at Station No. 1 on West Sixth Street, depth and quantity of water in reservoir, average temperature of air and water, and the average monthly and daily consumption of water, have been calculated and compiled from the records of the engineer and gatekeeper.

TABLE SHOWING WORK DONE WITH WORTHINGTON DUPLEX ENGINE FOR EACH MONTH  
DURING THE YEAR 1897.

MONTHS	No. of days pump- ing.	Average No. of hours pumping per day.	No. of hours pumping per month.	No. of strokes made per month.	Average No of strokes made per minute.	Average head, including friction, in feet.	Quantity pumped per month in U. S. gallons.	Average quantity pumped per day in U. S. gallons.	No. gals of water pumped into reservoir per lb. total coal consumed.	Duty in lbs. 1 ft high with 100 lbs. coal used in pumping only; no deduction for ashes or clinkers.	Duty on total coal consumed; no deduction for ashes or clinkers.
January . . . . .	....	....	.....	.....	.....	.....	.....	....	....	....	.....
February.....	11	20-18	223-15	156,277	11.67	160.86	48,445,870	4,404,170	330	44,430,912	44,24 ,280
March. ....	7	16-51	118-00	76,493	10.80	161.71	23,712,830	3,387,547	329	44,733,452	44,360,876
April.....	....	.....	.....	.....	.....	.....	.....	.....	....	.....	.....
May.. . . .	....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
June.....	....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
July.....	3	16-40	50-00	33,583	11.20	162.29	10,412,590	3,470,863	451	61,003,592	61,003,592
August .....	....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
September... ..	6	19-50	119-00	62,726	8.79	161.83	19,445,060	3,240,843	406	54,801,752	54,801,752
October.. . . .	6	19-58	119-45	67,612	9.41	161.22	20,959,720	3,493,287	400	53,721,026	53,721,026
November.....	4	14-11	56-45	30,408	8.93	161.33	9,426,480	2,356,620	316	46,183,477	42,469,357
December. ....	11	12-27	137-00	79,898	9.72	161.41	24,768,380	2,251,671	330	47,083,535	44,445,590
Totals and averages	48	17-09	823-45	507,003	10.26	161.40	157,170,930	3,274,394	352	46,137,307	44,297,236

TABLE SHOWING WORK DONE WITH WORTHINGTON HIGH DUTY ENGINE FOR EACH MONTH DURING THE YEAR 1897.

MONTHS.	No. of days pump- ing.	Average No. of hours pumping per day.	No. of hours pumping per month.	No. of strokes made per month.	Average No. of strokes made per minute.	Average head, including friction in feet.	Quantity pumped per month in U. S. gallons.	Average quantity pumped per day in U. S. gallons.	No. gals. of water pumped into reser- voir per lb. of total coal consumed.	Duty in lbs. 1 ft. high with 100 lbs. coal used in pumping only; no deduc- tion for ashes or clinkers.	Duty on total coal con- sumed; no deduction for ashes or clinkers.
January.....	31	23-16	721-30	379,394	8.76	164.10	142,272,750	4,589,444	571	79,328,416	78,055,477
February.....	21	19-52	417-15	242,691	9.69	164.08	91,009,125	4,333,768	619	86,473,275	84,707,518
March.....	26	20-41	537-45	313,390	9.71	162.98	117,521,250	4,520,048	639	80,802,983	86,850,612
April.....	30	20-41	620-30	331,823	8.91	164.21	144,433,625	4,147,888	615	89,939,548	84,161,073
May.....	31	17-47	551-30	287,740	8.70	164.28	107,902,500	3,480,726	636	9,121,809	87,032,442
June.....	30	20-00	599-45	271,014	7.53	164.20	101,690,250	3,387,675	611	89,113,638	83,646,694
July.....	30	22-51	685-15	337,442	8.21	163.93	126,540,750	4,218,025	648	89,180,469	88,104,757
August.....	31	24-00	744-00	310,454	6.95	164.37	116,420,250	3,755,492	662	91,154,017	90,635,958
September.....	28	22-30	589-00	255,426	7.23	163.91	95,784,750	3,684,029	652	89,014,688	89,014,688
October.....	27	22-59	620-30	265,692	7.14	163.68	99,634,500	3,690,67	647	88,786,312	88,210,090
November.....	14	22-41	317-30	126,554	6.64	163.30	47,457,750	3,389,890	621	92,287,281	84,444,337
December.....	12	11-55	143-00	66,523	7.75	163.16	24,945,750	2,078,813	468	83,308,202	63,619,442
Totals and averages..	309	21-11	6547-30	3,188,142	8.12	163.13	1,115,553,250	3,869,104	623	88,817,104	85,049,625

TABLE SHOWING AMOUNT OF COAL USED FOR  
WORTHINGTON DUPLEX ENGINE AT PUMP-  
ING STATION DURING THE YEAR 1897.

MONTHS.	COAL CONSUMED.			
	For starting fires, in lbs.	When pump- ing, in lbs.	For banking fires, in lbs.	Total per month, in lbs.
January.....	.....	.....	....	.....
February.....	400	146,175	200	146,775
March.....	400	71,440	200	72,040
April.....	.....	.....	.....	.....
May.....	.....	.....	.....	.....
June.....	.....	.....	....	.....
July.....	....	23,086	.....	23,086
August.....	.....	.....	..	.....
September.....	....	47,855	... ..	47,855
October.....	.....	52,422	.....	52,422
November.....	.....	27,443	2,400	29,843
December.....	....	70,764	4 200	74,964
Totals.....	800	439,185	7,000	446,985

**TABLE SHOWING AMOUNT OF COAL USED FOR  
WORTHINGTON HIGH DUTY ENGINE AT PUMP-  
ING STATION DURING THE YEAR 1897.**

MONTHS.	COAL CONSUMED.			
	For starting fires, in lbs.	When pump- ing, in lbs.	For banking fires, in lbs.	Total per month, in lbs.
January.....	3,000	245,276	1,000	249,276
February.....	2,000	143,917	1,000	146,917
March.....	5,200	175,794	2,800	183,794
April.....	9,000	189,339	4,000	202,339
May.....	10,200	149,021	10,500	169,721
June.....	6,600	156,065	3,600	166,265
July..	1,480	193,853	.....	195,333
August. ...	1,000	174,956	.....	175,956
September .....	.. ..	146,992	.....	146,992
October ..	1,000	153,078	....	154,078
November...	500	69,985	6,000	76,485
December.....	.....	40,718	12,600	53,318
Totals.....	39,980	1,838,974	41,500	1,920,474

TABLE SHOWING WORK DONE WITH WORKINGTON HIGH SERVICE ENGINE FOR EACH MONTH DURING THE YEAR 1897.

MONTHS.	No. of days pump- ing.	Average No. of hours pumping per day.	No. of hours pumping per month.	No. of strokes made per month.	Average No. of strokes made per minute.	Average head, including friction in feet.	Quantity pumped per month in U. S. gallons.	Average quantity pumped per day in U. S. gallons.	No. gals. of water pumped into reser- voir per lb. total coal consumed.	Coal in lbs used when pumping.
January.....	30	23-54	717-00	242,600	6.80	69.44	4,096,400	136,547	300	13,644
February.....	28	23-15	651-00	241,477	6.18	69.44	3,380,673	120,739	301	11,234
March. ....	29	23-17	675-00	252,343	6.23	69.44	3,532,802	121,821	300	11,776
April.....	30	23-38	709-00	281,788	6.62	69.44	3,945,032	131,501	302	13,076
May .....	30	22-02	661-00	258,007	6.51	69.44	3,612,008	120,403	299	12,074
June.....	28	23-15	651-00	234,344	6.00	69.44	3,280,816	117,172	300	10,935
July.....	31	23-16	721-30	285,211	6.59	69.44	3,942,954	128,805	300	13,294
August.. ..	31	24-00	744-00	319,967	7.17	90.51	4,479,538	144,501	300	14,924
September .....	30	24-00	720-00	315,005	7.29	92.59	4,410,070	147,002	300	14,696
October.....	31	24-00	744-00	326,502	7.31	92.59	4,571,028	147,453	300	15,235
November .....	26	17-18	450-00	251,871	9.33	73.89	3,526,194	135,623	302	11,677
December.....	24	11-33	277-00	161,079	9.69	69.44	2,255,106	93,963	300	7,523
Totals and averages.....	348	22-11	7,720-30	3,220,194	6.95	75.72	45,082,716	129,548	300	150,068

**PUMPING STATION, WORTHINGTON DUPLEX ENGINE,  
RUNNING EXPENSES FOR THE YEAR 1897.**

Pay of engineers and firemen .....	\$636 05
10 849-2000 tons of coal (Cumberland, 1897), at \$3.705..	38 62
31 1288-2000 tons of coal (Cumberland, 1897), at \$3.661	115 85
181 848-2000 tons of coal (Cumberland, 1897), at \$3.455	626 82
Electric light.....	25 64
Gas for lighting works.....	24 22
39.33 gallons of cylinder oil, at .527.....	20 73
11.11 gallons of engine oil, at .272 .....	3 02
18.33 pounds of packing, at .628.....	11 51
73.7 pounds of cotton waste, at .0675.....	4 79
Repairs on boilers.....	18 09
Tools and stock.....	4 61
Sundries.....	7 90
Total.....	<b>\$1,538 03</b>

Cost of pumping water into reservoir per million gallons, \$9.79.

Cost of pumping water one foot high per million gallons, .06 6-100

**PUMPING STATION, WORTHINGTON HIGH DUTY  
ENGINE, RUNNING EXPENSES FOR THE YEAR 1897.**

Pay for engineers and firemen.....	\$4,972 74
81 1005-2000 tons of coal (Cumberland, 1897), at \$3.705	301 97
247 802-2000 tons of coal (Cumberland, 1897), at \$3.661	905 74
631 667-2000 tons of coal (Cumberland, 1897), at \$3.455	2,181 26
Electric light.....	200 47
Gas for lighting works.....	189 37
307.54 gallons of cylinder oil, at .527.....	162 07
86.86 gallons of engine oil, at .272.....	23 63
143.32 pounds of packing, at .628.....	90 00
576.2 pounds of cotton waste, at .0675.....	38 89
Repairs on engine.....	5 75
Repairs on boilers.....	141 42
Tools and stock.....	36 06
Sundries.....	61 77
Total.....	\$9,311 14

Cost of pumping water into reservoir per million gallons, \$7.79.

Cost of pumping water one foot high per million gallons, .04 75-100.



## RESERVOIR, BEACON STREET, 1897.

MONTHS.	Depth in feet.	Quantity in U. S. gallons.	Temperature in degrees.	
			Of water.	Of air.
January . . . . .	18.88	28,632,651	42.32	27.16
February . . . . .	19.69	29,998,517	42.36	28.85
March . . . . .	19.32	29,362,797	43.76	35.26
April . . . . .	18.42	27,862,116	46.73	48.85
May . . . . .	19.13	29,047,411	52.49	58.12
June . . . . .	18.31	27,693,636	56.50	63.47
July . . . . .	18.07	27,287,075	57.60	73.05
August . . . . .	18.52	28,040,514	60.65	69.21
September . . . . .	18.74	28,403,527	60.60	62.21
October . . . . .	17.86	26,950,353	55.90	52.53
November . . . . .	18.91	28,682,678	47.23	37.89
December . . . . .	18.98	28,793,950	45.10	30.98

**TABLE SHOWING THE AVERAGE MONTHLY AND  
DAILY CONSUMPTION OF WATER  
FOR THE YEAR 1897.**

<b>Months.</b>	<b>Gallons per month.</b>	<b>Gallons per day.</b>
<b>January.....</b>	<b>230,097,061</b>	<b>7,422,486</b>
<b>February .....</b>	<b>197,409,449</b>	<b>7,050,337</b>
<b>March.....</b>	<b>201,446,170</b>	<b>6,498,264</b>
<b>April.....</b>	<b>185,625,235</b>	<b>6,187,508</b>
<b>May.....</b>	<b>198,432,634</b>	<b>6,401,053</b>
<b>June .....</b>	<b>188,901,172</b>	<b>6,296,706</b>
<b>July.....</b>	<b>213,442,408</b>	<b>6,885,239</b>
<b>August .....</b>	<b>196,972,688</b>	<b>6,353,958</b>
<b>September .....</b>	<b>190,445,293</b>	<b>6,348,176</b>
<b>October.....</b>	<b>195,333,648</b>	<b>6,301,085</b>
<b>November .....</b>	<b>194,970,795</b>	<b>6,499,027</b>
<b>Dccember.....</b>	<b>213,866,461</b>	<b>6,898.918</b>
<b>Totals and averages .....</b>	<b>2,406,943,014</b>	<b>6,594,364</b>

## SUMMARY OF STATISTICS.

REPORT OF 1897.

*In accordance with the recommendations of the New England  
Water Works Association.*

## LOWELL WATER WORKS, MIDDLESEX COUNTY, MASS.

Population by census of 1895, 84,359.

Date of construction, 1870 to 1873.

Date of construction, High Service, 1881.

Date of construction, Driven Wells, 1893 to 1896.

Source of supply—Two hundred twenty (220) driven wells in the valley of River Meadow Brook and one hundred sixty-nine (169) driven wells at Pawtucket Boulevard, and filter gallery.

Mode of supply—Pumping to reservoir and pumping direct.

## PUMPING.

## 1. Builders of pumping machinery:

One engine, capacity 5,000,000 gals. in 24 hours, Henry G. Morris.

One engine, capacity 5,000,000 gals. in 24 hours, Henry R. Worthington.

One engine, capacity 10,000,000 gals. in 24 hours, Henry R. Worthington.

One engine, capacity 500,000 gals. in 24 hours, Henry R. Worthington.

One engine, capacity 3,000,000 gals. in 24 hours, The Deane Steam Pump Co.

One engine, capacity 3,000,000 gals. in 24 hours, The Deane Steam Pump Co.

One engine, capacity 3,000,000 gals. in 24 hours, Henry R. Worthington.

One engine, capacity 3,000,000 gals. in 24 hours, Henry R. Worthington.

One engine, capacity 3,000,000 gals. in 24 hours, Knowles Steam Pump Works.

One engine, capacity 3,000,000 gals. in 24 hours, Knowles Steam Pump Works.

2. Description of coal used :

- (b) Kind, bituminous.
- (c) Size, broken.
- (d) Brand, Cumberland.
- (e) Price per gross ton delivered, \$3.940.

3. Coal consumed for the year, in pounds, 2,367,459.

4. Wood consumed for the year, in pounds.

$$\frac{\text{---}}{3} = \text{coal in lbs.} = 2,400.$$

5. Total fuel consumed for the year, in pounds, 2,369,859.

6. Total pumpage for the year in gallons, 1,352,724,180.

7. Average static head against which pumps work, 156.72.

8. Average dynamic head against which pumps work, 162.66.

9. Number of gallons pumped per pound of coal, 571.

10. Duty in foot pounds per 100 pounds of coal using the following formula, making no deduction for starting or banking fires, or heating building :—

$$\text{Duty} = \frac{\text{Gallons pumped (6) } \times 8.34 \text{ (lbs.) } \times 100 \times \text{dynamic head (8)}}{\text{Total fuel consumed (5)}} = 77,434,333$$

COST OF PUMPING FIGURED ON PUMPING STATION EXPENSES OF  
\$10,849.17.

11. Per million gallons raised against average dynamic head (8) into reservoir, \$8.02.

12. Per million gallons raised one foot high (dynamic), .04  $\frac{23}{100}$ .

2 to 5 and 7 to 12 inclusive do not include driven wells.

6 includes pumpage from driven well plant at Pawtucket Boulevard.

Pumpage from driven wells in valley of River Meadow Brook,  
1,053,516,272 gallons.

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### NEW SUPPLY.

The water furnished for the past year by the City of Lowell for all purposes has been driven well water, except a small amount supplied by the filter gallery. The full amount used by the city was 6,594,364 gallons per day, 450,000 gallons of which were supplied by the filter gallery. The available area of the filter gallery for filter purposes is 9,150 square feet, yielding at the rate of 2,164,000 gallons per acre per day. This water is not so good as well water as it contains more iron, but it is softer and perfectly safe to use. The filter gallery has a storage capacity for 500,000 gallons which can be used so that either the Boulevard plant or the West Sixth Street pumping station can be run for a short time independently of the other.

In my report last year I advised the lowering of the suction pipe at the first driven well station. This work was begun but was discontinued on account of the amount of water in the valley owing to the wet season; when practicable, however, it should be finished. The water from the second driven well station has been very satisfactory both in quantity and quality.

The third tube well plant or Boulevard plant, built by

B. F. Smith and Brother of Boston, has been accepted by the city during the past year. My certificate was sent to the Water Board April 30th, stating that the contract between the City of Lowell and B. F. Smith and Brother was completed and that the contractors were entitled to the full payment for 3,000,000 gallons, also, by a supplementary contract for 1,500,000 gallons extra, making 4,500,000 gallons in all. This plant has never been pumped to its limit, the amount of water the contractors were allowed to pump each day being fixed by the Superintendent of Water Works.

Before closing this report I wish to refer to the faithful and thorough manner in which B. F. Smith and Brother have constructed this plant. It was very difficult to locate requiring the driving and pulling up of one hundred forty-three wells before a suitable location could be obtained. The outlook for water was for a time very doubtful, but they were always ready to try any experiments suggested and after a long struggle succeeded far beyond our expectations. This plant, for a temporary one, is in excellent condition and is placed in a public park or common. There should be a certain amount of money expended by the Water Works Department each year for the improvement of this park. The land is too low to be planted; it is overflowed in times of high water and any trees and shrubbery there would be hurt by the floating ice. It would, however, make a good place for athletic grounds, and when a permanent building is constructed it should be large enough for a good park shelter with dressing and toilet rooms for people engaged in these sports. I believe that when such a building is erected this plant can be run by electricity generated at the West Sixth Street pumping station as economically as by a separate steam plant. This would make a very fine feature and would be a great benefit to the Boulevard Park.

A sample of water from each well plant every month that the plants have been in operation, also one from the Merrimack river, has been analyzed by the State Board of Health. A copy of the analysis, which will be found annexed to this report, has been sent me as soon as possible, so that the quality of the water has been very carefully watched.

The City of Lowell has now an abundance of water of excellent quality, and the problem is how to keep it so. In the summer months algae will grow in all ground water which is exposed to the light in an open reservoir. The only way to remedy this is to exclude the light from the water either by using a covered reservoir or stand-pipe, or by continuous pumping into the system, thereby omitting the use of the reservoir. I would recommend that a new covered reservoir with a capacity of about one day's supply be built at an elevation between that of the present low service reservoir and that of the Proprietors of the Locks and Canals, so as not to change the present fire service connections between the city and corporations; also that a covered stand-pipe having a capacity of about 500,000 gallons be built for the high service. This would give a better water pressure all over the city, a result very much desired by the corporations and by the people living in the high districts of the city. When these improvements are completed the Lowell Water Works system will be second to none.

Respectfully submitted,

GEORGE BOWERS,

*City Engineer.*

COMMONWEALTH OF MASSACHUSETTS  
WATER

STATE BOARD OF HEALTH, LOWELL,  
S.

WATER ANALYSIS

Iron.	Oxygen Consumed.	REMARKS.
...	.3942	Merrimack River.
...	.4940	" "
...	.5360	" "
...	.5020	" "
...	.6240	" "
...	.7400	" "
...	.8202	" "
...	.5206	" "
...	.3488	" "
...	.3280	" "
...	.3940	" "
...	.5288	" "



COMMONWEALTH OF MASSACHUSETTS.—STATE BOARD OF HEALTH, LOWELL.

WATER ANALYSIS.

(PARTS IN 100,000).

No.	DATE OF		APPEARANCE.			ODOB.		RESIDUE ON EVAPORATION.			AMMONIA.			Chlorine.	NITROGEN AS		Hardness.	Iron.	Oxygen Consumed.	REMARKS.
	Collection.	Examination.	Turbid ity.	Sediment.	Color	Cold.	Hot.	Total	Loss on Ignition.	Fixed.	Free.	Total.	In solution.	Insuspens'n.	traces.	traces.				
18,296	Jan., 19	1857	None.	None.	0.00	None.	None.	9.20	...	....	.0002	.0030	....	....	.0380	.0000	3.2	.0080	.0730	Cook Wells.
18,791	March 15	17	None.	Very slight	0.02	None.	None.	8.40	....	....	.0004	.0038	....	....	.0270	.0001	3.6	.0100	.0480	" "
19,065	April 20	21	None.	None.	0.02	None.	None.	8.00	...	....	.0040	.0024	....	....	.0500	.0002	3.8	.0060	.0720	" "
19,469	June 15	16	None.	None.	0.01	None.	None.	8.10	...	....	.0004	.0008	....	....	.0750	.0000	3.4	.0030	.0680	" "
19,835	July 20	21	None.	None.	0.02	None.	None.	8.70	....	....	.0000	.0040	....	....	.0450	.0000	3.3	.0020	.0722	" "
20,126	Aug. 17	18	None.	None.	0.03	None.	None.	8.10	....	....	.0006	.0038	....	....	.0280	.0000	3.5	.0040	.1102	" "
20,594	Sept. 21	22	None.	None.	0.00	None.	None.	8.80	....	....	.0010	.0058	....	....	.0170	.0000	3.8	.0020	.1000	" "
20,886	Oct. 19	20	None.	None.	0.05	None.	None.	8.50	....	....	.0004	.0020	....	....	.0400	.0000	3.8	.0030	.0640	" "
21,265	Nov. 16	17	None.	Very slight	0.06	None.	None.	9.60	....	....	.0012	.0056	....	....	.0150	.0001	4.6	.0030	.0880	" "
21,659	Dec. 24	27	None.	Very slight	0.01	None.	None.	9.70	....	....	.0000	.0034	....	....	.0430	.0002	4.4	.0030	.0800	" "

COMMONWEALTH OF MASSACHUSETTS.—STATE BOARD OF HEALTH, LOWELL.

WATER ANALYSIS.

(PARTS IN 100,000).

No.	DATE OF Collection.		APPEARANCE.			ODOB.		RESIDUE ON EVAPORATION.				AMMONIA.			Chlorine.	NITROGEN AS		Hardness.	Iron.	Oxygen Consumed.	REMARKS.
			Turbid- ity.	Sediment.	Color	Cold.	Hot.	Total	Loss on drying	Fixed.	Free.	Total	In so- lution.	In sus- pension.							
18,522	Feb. 15	1897	None.	Very slight	0.07	None.	None.	10.80	....	....	.0070	.0048	....	....	.32	.0080	.0001	4.6	.0330	.1000	Hydraulic Wells.
18,792	March 16	17	None.	None.	0.10	None.	None.	11.00	....	...	.0064	.0054	....	...	.33	.0060	.0000	5.3	.0570	.0680	"
19,278	May 18	19	Distinct.	Cons. flocculent iron.	0.25	None.	None.	10.60	....	....	.0086	.0050	....	...	.32	.0030	.0000	4.9	.0850	.1520	"
20,127	Aug. 17	18	Distinct milky.	Very slight	0.36	None.	None.	9.50	....	....	.0072	.0052	....	....	.32	.0060	.0000	4.3	.0450	.2546	"
21,266	Nov. 16	17	Decided.	Heavy iron	0.21	Faint.	Faint.	10.00	....	....	.002	.0080	...	...	.45	.0030	.0001	4.7	.0350	.1920	"
21,650	Dec. 24	27	Decided.	Cons.	0.19	None.	None.	10.20	....	..	.0094	.0062	....	..	.38	.0060	.0001	5.1	.0330	.1840	"

# COMMONWEALTH OF MASSACHUSETTS.—STATE BOARD OF HEALTH, LOWELL.

## WATER ANALYSIS.

(PARTS IN 100,000).

No.	DATE OF COLLECTION.		APPEARANCE.			ODOR.		RESIDUE ON EVAPORATION.			AMMONIA.			Chlorine	NITROGEN AS		Hardness	Iron.	(Oxygen Consumed)	REMARKS.	
			Turbidity.	Sediment	Color			Cold.	Hot.	Total Solids.	Fixed Solids.	Free.	Total.		In solution.	% Nitrate.					% Nitrite.
18,297	Jan. 19	1897	21	None.	Very slight	0.02	None.	None.	5.90	....	....	.0056	.0030	....	.28	.0280	.0000	.23	.0190	.0073	Boulevard Wells.
18,540	Feb. 17	18	18	None.	None	0.05	None.	None.	4.60	....	....	.0080	.0032	....	.28	.0200	.0001	2.1	.0300	.0320	"
18,730	March 16	17	17	None	None.	0.12	None.	None.	5.10	....	....	.0076	.0022	....	.29	.0300	.0000	2.3	.0110	.0480	"
19,084	April 20	21	21	Very slight.	Very slight	0.05	None.	None.	4.50	....	....	.0086	.0022	....	.24	.0200	.0001	2.1	.0180	.0760	"
19,277	May 18	19	19	Very slight.	Very slight non.	0.12	None.	None.	3.70	....	....	.0086	.0028	....	.25	.0270	.0000	1.7	.0200	.0200	"
19,470	June 15	16	16	None.	None.	0.04	None.	None.	4.00	..	....	.0070	.0030	....	.16	.0390	.0010	1.6	.0130	.0832	"
19,831	July 20	21	21	Very slight.	Very slight	0.14	None.	None.	4.00	....	....	.0120	.0014	....	.22	.0125	.0002	1.4	.0250	.0467	"
20,128	Aug. 17	18	18	None.	Very slight	0.14	None.	None.	4.70	....	....	.0142	.0036	....	.20	.0160	.0001	1.7	.0250	.0150	"
20,537	Sept. 21	22	22	None.	None.	0.10	None.	None.	4.50	....	....	.0128	.0018	....	.22	.0150	.0000	1.6	.0280	.0800	"
20,857	Oct. 19	20	20	None.	Very slight	0.10	None.	None.	4.60	....	....	.0120	.0024	....	.27	.0480	.0000	1.7	.0250	.0440	"





TWENTY-SIXTH  
ANNUAL REPORT  
OF THE  
LOWELL WATER BOARD  
TO THE  
CITY COUNCIL OF THE CITY OF LOWELL, MASS.,  
AND THE  
REPORTS OF THE SUPERINTENDENT OF WATER WORKS AND OF THE  
CITY ENGINEER TO THE WATER BOARD FOR 1898.

LOWELL, MASS.:  
LOWELL SUN PRINT. SUN BUILDING  
1899.



HF 50-100  
10-11-1942  
142842



# WATER DEPARTMENT, 1898.

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## WATER BOARD.

**FRANK L. WEAVER, President.**

Term expires second Monday in March, 1900.

**STEPHEN H. JONES,**

Term expires second Monday in March, 1899.

**MICHAEL J. DOWD,**

Term expires second Monday in March, 1901.

**AUGUST FELS,**

Term expires second Monday in March, 1902.

**J. W. CRAWFORD, Secretary and Clerk.**

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**ROBERT J. THOMAS, Superintendent.**

**GEORGE BOWERS, City Engineer.**

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**D. B. H. BARTLETT, Engineer,**

**WILLIAM JOYCE, Asst. Foreman.**

**THOMAS McLOUGHLIN, Engineer.**

**JOHN E. LONEY, Meters.**

**FRANK LAPOINT, Reservoir.**

**ARTEMAS S. YOUNG, Foreman Shop.**

**THOMAS F. DOYLE, Foreman.**

**A. F. COGER, Hydrants and Gates.**

**THOMAS ROGERS, Services.**

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## OFFICE.

**LEONARD T. FARRIS, Service Clerk.**

**GERTRUDE W. BYAM, Bookkeeper.**

**JULIA J. RAFTER, Asst. Bookkeeper.**

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## INSPECTORS.

**ROBERT GARDNER, JR.**

**MICHAEL H. McCUE.**

**GEORGE E. WORTHEN.**

**GEORGE F. TILTON.**

**WALTER P. WILEY.**



# REPORT OF THE WATER BOARD.

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OFFICE OF THE WATER BOARD,  
CITY HALL,

LOWELL, MASS., Jan. 23, 1899.

*To His Honor the Mayor and City Council of  
the City of Lowell.*

Complying with the requirments of the City Ordinances, herewith is presented the twenty-sixth annual report of the Water Board for the year ending December 31st, 1898, together with the Superintendent's and City Engineer's reports of the operations and improvements made in the department during the year.

There has been no change in the membership, as Mr. Fels was re-elected for another term in the Board. But Mr. Charles E. Howe, who was elected a member of the Water Board in 1896 from the Board of Alderman, ceased to take part in the deliberations of this Board after

the City Solicitor had rendered a decision to the President that under the terms of the Amended Charter a member of the Board of Aldermen is not eligible to hold a place in the Water Board.

The only new work of any magnitude has been the laying of 24-inch pipe through the Gallery and the grading and fencing of the land purchased on the line of the Conduit; the work of laying the pipe through the Gallery cost \$2,977.53 and the pipe, purchased last year, cost \$2,372.44, making a total of \$5,349.97 for this improvement. The amount expended for grading and fencing was \$5,335.08 and the City land in Pawtucketville under the jurisdiction of the Water Department is now well defined and protected from encroachment, which will prevent a repetition of the state of affairs on the extension of Third Avenue over the Conduit near Mammoth Street and which it is proposed to lay out as an accepted Street, where it is found that three houses are encroaching upon the City's land from three to five feet and the yard fenced in takes in from twelve to fifteen feet. It has been proposed to re-adjust the lines of the street so as to bring the outside limit ten feet nearer the Conduit on one side and ten feet further away on the other side, but this Board objects to this device for settling the case; the houses should be removed from within the limits of the Conduit line. After all the effort

and expense expended by the Board in removing houses and preventing the erection of buildings on or near the Conduit, to protect the water from pollution, we will not give our consent to an exception to the rule on this most dangerous part of the Conduit.

After the work of widening Andover Street had progressed for a time, the Water Board was advised that the water pipe for about 2400 feet would be in the middle of the street, under the car tracks, and we were requested to move it to one side; but as no provision was made to reimburse the Department for this expense, the pipe was allowed to remain in the middle of the street; but a number of hydrants had to be removed at considerable expense.

On January 25th an order was adopted by the City Council for a Committee to confer with the Water Board as follows:

## CITY OF LOWELL.

### IN BOARD OF ALDERMEN.

Order providing for the appointment of a Joint Special Committee to confer with the Water Department.

Ordered, if the Common Council concur, That a Joint Special Committee be appointed, consist-

ing of two members of the Board of Aldermen, to be appointed by the Mayor, and three members of the Common Council, to be appointed by the President of the Common Council, to investigate the acts, doings and transactions of the Water Board, including the past transactions and business of said Board, for such period of time as said Committee may deem expedient; to consider also the present needs and requirements of the Water Department, and the business to be transacted therein during the current year, so far as the same can now be anticipated, with a view to ascertaining, what, if any, changes are required in the Ordinances relating to said Department or in the methods in which the business is conducted, to secure a more economical and efficient administration of the affairs of said Department.

Said Committee is hereby invested with full authority to examine all books, papers, records and accounts of said Department; to hold public hearings, if it shall deem it expedient to do so; to summons witnesses to appear before said Committee and give evidence relating to any matter pertinent to such investigation; to employ a stenographer and such clerical assistance as it may deem necessary and proper in the premises; and to report to the City Council its doings and findings in the premises, and such recommendations as said Committee may deem proper.

The expenses, not to exceed \$100, incurred by said Committee in carrying out this order, shall be charged to the appropriation for incidental expenses of the City Council.

Adopted January 25, 1898; approved January 27, 1898.

Attest:

GIRARD P. DADMAN,

City Clerk.

Committee:—Aldermen Dimon and Tuttle, Councilmen Murkland, Leighton and Roark.

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The Committee met with the Water Board on March 24th. Aldermen Dimon and Tuttle and Councilman Roark, and on April 7th the Committee made the following report to the City Council:

LOWELL, MASS, April 7, 1898.

*To the Mayor and Honorable Board of Aldermen  
and Common Council of the City of Lowell:*

GENTLEMEN,—Your Committee, appointed by His Honor the Mayor and the President of the Common Council to carry out the provisions of a

joint order, duly passed by both your honorable boards, entitled "An order to confer with the Water Board," etc., a copy of which is hereby annexed, would respectfully report:

That they have made a preliminary examination under this order and are satisfied that the subject (involving, as it does, questions of such grave and vital importance to the citizens of Lowell in relation to the best and most economical method of obtaining a pure water supply, and requiring opinions as to the management for a long term of years, also requesting suggestions so as "to require a more efficient and economical administration of the affairs of the Water Board") requires more time and attention than your Committee, temporarily appointed, can be reasonably expected to give, with the limited time at their disposal and small amount appropriated for this research, and would respectfully ask to be discharged from further duty.

Your Committee are of the opinion that, in justice to all concerned, they should report that as far as they have investigated there does not seem the slightest occasion to doubt that the administration of the Water Department is conducted honestly and conscientiously, as the members deem for the best interests of the City. There is a grave doubt in the minds of the Committee as to the advisability of so much power (as the ordinances seems to give them), to act



independently of the City Council in the expenditures of receipts from the Department, and without any provision for a yearly examination and official endorsement of their acts.

(Signed.)

CHARLES A. R. DIMON, Chairman.

FREDERICK A. TUTTLE,

WALTER E. MURKLAND,

WALTER F. LEIGHTON,

JOHN J. ROARK.

On June 21, Mr. Leonard T. Farris, a Clerk in the Water Office since 1873 resigned his position on account of failing health and it was with regret that the members felt called upon to accept it. Mr. Farris has been a familiar figure in the Water Office for twenty-five years, from the very beginning, and his absence will be greatly missed by his associates and the public generally. Mr. George E. Worthen, inspector for a number of years and formerly employed in the office, was elected to fill the place, and Mr. Samuel D. Butterworth was elected an Inspector to fill the place made vacant by the transferring of Mr. Worthen.

Continuing our efforts to preserve the purity of the water in the conduit, we purchased of Edward T. Genest a strip of land ten feet wide near Gershon Avenue and Moody Street on which is a barn which is to be removed.

The Secretary's report of the finances of the Department show a reduction in the amount expended from the previous year of \$17,029.68, but the receipts also fall off \$17,312.17 and our balance decreased \$3,177.70. It is fair to say, however, that an extensive job of pipe laying, including hydrants and gates for fire purposes for the Stirling, Faulkner and Belvidere No. 2 Mills, and amounting to over \$3,000.00 and be paid by these mills, will cover the deficiency.

The Committee on Appropriations for 1898 refused to make provision for an appropriation for this Department for care of fire hydrants as in previous years, amounting to \$11,977.20 and about \$400.00 for street fountains; these amounts, if received, would have shown a good excess over expenditures.

At the time the committee was appointed to confer with the Board, it was stated publicly that 1897 was the first time in twenty-one years that there had been a deficit and appeared to be the chief reason for the appointment of the committee. As a matter of fact, there has been a deficit thirteen times from 1876 to 1896. The year 1886 was the first time in which there was a clear excess of receipts over expenditures, including interest, and since then there have been four times that the expenditures exceeded the receipts as follows:

## EXCESS AND DEFICIT.

1886—Excess,	\$ 1,414.01.	
1887—Excess,	1,328.24.	
1888—Deficit,	140.36.	Reduced price for hydrants, \$6,000.00.
1889—Deficit,	4,287.82.	
1890—Deficit,	144.52.	
1891—Excess,	25,785.86.	Interest charges reduced, \$60,000.00.
1892—Excess,	2,452.89.	Water rates reduced 10 per cent,—\$16,764.00.
1893—Deficit,	7,738.70.	
1894—Excess,	7,564.24.	Reduced meter rates.
1895—Excess,	1,974.67.	
1896—Excess,	5,393.40.	Increase of new meters.
1897—Deficit,	2,895.21.	
1898—Deficit,	3,176.70.	No pay for hydrants.

It will be seen by this table that every time the income has equalled the expenditures, a reduction of rates has followed.

The increase in new meters in the last three years is responsible for a great deal of the decrease in charges for water, as over nine hundred new meters were set in excess of the new services; consequently that number of "rate payers"

were changed to meter rates, which means less for them to pay and a corresponding loss of income to the city. For 1888 the amount paid for care of hydrants was \$9,336.00, and it has increased with the addition of new ones each year to \$11,977.20 for 1898, therefore it will be readily seen that in every year since, excepting in 1891, the excess would have been a deficit without the hydrant money and the years showing a deficit would have been from \$9,000 to \$11,000 greater. Why should not property pay a tax to maintain the Water Works? The works are constructed with a view to the purpose of fire protection; the rates charged are based on a price for each fixture or by meter for amount used and do not comprehend the use for fire purposes. The charge for water in a cottage with a sink, bath tub, water closet and hose is \$16.00 per year, while a big ten-story store-house does not use a drop of water and pays nothing, although it requires four big hydrants to be set near by for protection. With the present rates for water and the rapid changing from faucet rates to meters each year, unless the Department has pay for the hydrants we shall be seriously crippled and it will be impossible to make the many extensions of water mains constantly being asked for.

The Secretary's tables show that charges for water decreased \$1,881.69. The total charges were:

For water . . . . .	\$220,642 73
Other charges . . . . .	14,091 84
Uncollected from 1897 . . . . .	29,089 41
	<hr/>
	\$263,323 98
Collections . . . . .	\$194,292 30
Discount . . . . .	20,561 55
Abatements . . . . .	4,587 61
Uncollected to 1899 . . . . .	44,382 52
	<hr/>
	\$263,823 98
Balance January 1, 1898 . . . . .	\$ 33,384 45
Receipts . . . . .	194,291 30
	<hr/>
	\$227,675 75
Expended 1898 . . . . .	\$197,469 00
Balance January 1, 1899 . . . . .	30,206 75
	<hr/>
	\$227,675 75

The details of the work done by the Department during the year will be found in the very complete report of Superintendent Thomas, and the details of duty and cost are contained in the Engineer's tables.

FRANK L. WEAVER,  
AUGUST FELS,  
MICHAEL J. DOWD,  
STEPHEN H. JONES.

LOWELL WATER WORKS OFFICE,

January 1, 1899.

TO THE LOWELL WATER BOARD:

Gentlemen,—Herewith I submit figures detailing the finances of the Lowell Water Works for the year ending December 31st, 1898,

J. W. CRAWFORD,

Clerk.

TABLE I. FINANCIAL STATEMENT—LOWELL WATER WORKS, 1898.

CHARGES										RECEIPTS									
Water										By Accounts									
Rate		Metered		Total		Other than Water		Total Charges 1898		Total Charges 1897		Receipts		Discounts		Aba'ments		Due	
Transfer .....								\$29,089 41		\$28,686 26		\$24,951 52		\$2,587 18		\$282 97		\$1,257 74	
\$ 219 01		\$ 2 10		\$ 221 11		\$1,150 85		1,371 96		980 04		1,359 68		6 78		4 25		1 25	
January .....																			
11 82				11 82		1,070 35		1,082 17		1,747 81		1,027 05		1 79		6 49		46 84	
February .....																			
92,785 52		25,793 71		118,589 23				118,589 23		112,344 86		91,233 58		10,448 68		3,415 62		13,491 37	
March .....																			
1,581 72				1,581 72		1,848 33		3,430 05		18,156 03		2,849 27		149 94		272 74		158 10	
April .....																			
1,237 22				1,237 22		1,341 94		3,579 16		3,680 41		2,208 03		119 86		110 14		141 63	
May.....																			
1,945 81		37,891 10		39,836 91		1,701 08		41,537 99		36,968 61		36,911 68		3,945 23		173 68		507 40	
June.....																			
98 06		9 10		107 16		1,835 57		1,942 73		3,688 60		1,611 17		13 64		10 48		307 44	
July.....																			
615 50		10 78		626 28		982 27		1,608 55		1,856 81		1,310 16		56 15		80 17		152 07	
August .....																			
370 62		31,149 77		31,520 39		1,007 20		32,529 59		30,669 03		28,619 00		3,114 85		154 54		639 20	
September.....																			
343 46		20 33		363 79		880 81		1,244 60		1,793 41		805 59		24 26		42 59		372 16	
October.....																			
160 20		9 38		169 58		1,062 50		1,252 08		1,122 78		482 70		3 79		13 94		751 65	
November.....																			
421 76		25,955 76		26,377 52		1,190 94		27,568 46		26,594 80		922 87		99 92		.....		26,555 67	
December.....																			
Totals .....		\$120,842 03		\$220,642 73		\$14,091 84		\$263,823 98		\$268,331 56		\$194,202 30		\$20,561 55		\$4,587 61		\$44,382 52	

TABLE II.

FINANCIAL STATEMENT—LOWELL WATER WORKS, 1898.

OUTGO.

Month	Pay Rolls and Salaries	Water Works Supplies	Interest and Principal	Refunds and Vouchers	General Expense Account	Stable Department	Laying Pipe in Gallery	Grading and Fencing	Land	COAL				Totals	
										P. S. 1	P. S. 2	P. S. 3	P. S. 4	1898	1897
January	\$4,820 46	\$389 37	\$80 00	\$63 16	\$68 19	\$33 68	.....	.....	\$4,853 15	.....	\$422 95	\$654 16	\$246 69	\$11,681 81	\$12,345 24
February	3,337 63	955 89	7,972 50	10 00	229 59	214 24	.....	.....	.....	.....	.....	159 77	.....	12,879 62	13,792 85
March	3,515 24	2,361 09	480 00	5 15	187 07	75 57	.....	.....	.....	\$1,456 76	2,069 90	1,351 92	853 70	12,356 39	14,169 57
April	5,362 59	3,948 72	80 00	3 60	85 41	225 26	\$75 00	.....	.....	.....	.....	.....	.....	9,780 58	20,006 42
May	5,087 03	1,381 02	13,840 00	1,200 57	70 92	69 17	521 36	.....	.....	.....	2,400 77	956 42	.....	30,536 26	38,063 38
June	5,045 38	2,103 38	3,500 00	58 08	197 70	39 59	688 91	43 25	.....	.....	.....	.....	.....	11,686 29	16,785 70
July	6,466 10	1,546 51	10,360 00	88 37	130 99	44 49	5 37	805 87	.....	1,870 65	.....	.....	777 74	22,096 09	21,205 58
August	5,066 12	1,141 20	1,912 50	128 38	162 28	61 27	32 25	464 78	.....	1,834 07	.....	1,021 19	203 38	12,127 42	11,169 14
September	4,891 96	1,525 50	560 00	53 86	140 57	28 71	.....	409 47	.....	.....	.....	.....	.....	7,610 07	9,998 25
October	6,815 06	4,324 43	4,420 00	19 82	84 45	142 86	.....	322 06	157 82	.....	.....	.....	.....	16,286 50	20,068 74
November	5,732 90	1,207 99	19,900 00	26 63	81 06	94 79	.....	.....	.....	1,295 02	485 82	.....	1,523 75	30,348 56	26,409 99
December	6,273 16	1,000 22	12,380 00	115 20	181 25	179 58	.....	.....	.....	.....	.....	.....	.....	20,129 41	10,485 83
Totals	\$62,413 63	\$21,885 32	\$80,186 00	\$1,781 82	\$1,619 48	\$1,209 21	\$1,332 89	\$2,045 43	\$5,010 97	\$6,557 09	\$5,379 44	\$4,143 46	\$3,605 26	\$197,469 00	\$214,498 68



TABLE III. FINANCIAL STATEMENT—LOWELL WATER WORKS, 1898.

SUBDIVISION OF "OTHER THAN WATER CHARGES" FROM TABLE 1.

	Meters Sold	Expense Setting Meters	Meter Repairs	New Services	Relaid Services	Labor and Material	Lime Charges	Shut-off Fees	Sewer Flushing	Interest	Totals	
											1898	1897
January...	\$639 50	72 60	31 72	\$13 20	\$15 00	\$326 07	\$32 76	.....	.....	.....	\$1,150 85	\$911 34
February..	716 50	77 21	54 38	40 04	23 73	137 15	11 34	8 00	2 01	.....	1,070 35	1,684 58
March.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
April .....	968 70	113 62	48 53	332 29	204 91	151 60	10 68	10 00	8 00	.....	1,848 33	2,786 04
May.....	663 70	91 76	19 50	199 78	134 92	152 32	69 96	6 00	4 00	.....	1,341 94	1,915 96
June.....	936 00	143 69	3 75	155 07	107 03	222 28	37 26	2 00	4 00	.....	1,701 08	1,420 16
July .....	1,117 50	157 80	10 00	72 25	112 30	256 44	29 28	72 00	8 00	.....	1,835 57	2,492 35
August .....	422 50	64 18	6 50	113 10	100 34	210 42	49 23	12 00	4 00	.....	982 27	1,586 10
September.	270 50	32 16	.....	142 32	120 10	86 03	38 82	4 00	8 00	305 27	1,007 20	1,166 81
October . . .	251 00	36 03	21 05	46 80	105 86	382 07	30 00	4 00	4 00	.....	880 81	1,548 39
November..	297 00	49 49	.....	167 48	145 97	371 24	43 32	.....	8 00	.....	1,082 50	991 88
December..	261 50	32 27	14 90	354 32	101 37	409 70	8 88	8 00	.....	.....	1,190 94	607 25
Totals.....	\$6,584 40	\$870 81	\$210 33	\$1,636 65	\$1,171 53	\$2,775 32	\$361 53	\$126 00	\$50 00	\$305 27	\$14,091 84	\$17,110 86

TABLE IV. FINANCIAL STATEMENT—LOWELL WATER WORKS, 1898.

SUBDIVISION OF "PAY ROLL AND SALARIES" FROM TABLE II.

	Salaries Pres'd't and Superin- tendent	Office and Inspec- tors	New Meter Work	Meter Repairs	Exten- sion and Con- struction	Engin- eering	Pumping Stations				Mainten- ance	Reser- voir	New Services	Relaid Services	Re- charged Sundry Persons	Totals	
							Station 1	Station 2	Station 3	Station 4						1898	1897
January,...	\$183 33	\$834 25	\$24 25	\$193 50	\$568 44	\$169 00	\$406 65	\$525 95	\$397 50	\$269 50	\$1,070 19	\$57 54	\$5 25	\$52 11	\$4 00	\$4,820 46	\$5,701 13
February	183 34	657 40	4 50	267 94	76 70	94 25	243 97	376 86	344 25	254 75	762 74	46 04	.....	13 50	1 39	3,337 63	3,608 11
March	183 33	657 40	30 30	285 21	76 70	78 00	273 19	402 36	228 00	283 06	858 81	46 04	39 00	60 75	.....	3,515 24	3,746 23
April.....	183 33	834 25	220 75	107 50	384 04	97 50	481 65	529 95	20 00	433 50	1,569 56	56 55	223 66	201 35	18 00	5,362 59	4,906 81
May.....	183 34	657 40	73 50	119 25	377 34	79 13	203 74	451 61	282 94	206 34	2,040 70	46 04	194 32	161 38	.....	5,087 03	6,178 61
June	183 33	590 68	94 00	156 25	551 30	89 25	342 61	401 56	226 11	274 86	1,704 57	46 04	228 14	156 68	.....	5,045 38	7,338 57
July.....	183 33	834 25	181 50	155 25	175 33	151 50	572 17	423 29	85 01	465 26	2,678 88	57 55	133 69	225 05	79 08	6,466 10	5,994 54
August.....	183 34	657 40	68 50	102 75	575 67	71 50	449 72	374 61	15 75	346 25	1,822 10	46 04	159 22	171 72	11 55	5,066 12	5,124 56
September	183 33	657 40	44 06	48 25	158 15	78 00	449 72	389 86	14 00	307 25	2,206 46	46 04	160 39	100 55	29 50	4,891 96	5,069 26
October...	183 34	834 25	37 00	37 50	1,320 72	100 75	557 15	199 45	455 74	419 50	1,792 19	57 55	58 56	173 68	587 70	6,815 06	5,705 93
November.	183 34	657 40	20 17	42 78	1,278 08	78 00	536 72	458 47	56 08	355 58	1,171 13	46 04	97 41	134 83	606 77	5,732 90	4,671 61
December.	133 33	834 25	77 75	45 25	980 95	97 50	627 90	540 20	119 52	450 75	1,703 17	56 55	113 22	127 61	534 21	6,273 16	4,719 45
Totals.....	\$2,200 00	\$8,766 33	\$936 37	\$1,561 43	\$6,503 42	\$1,184 38	\$5,144 19	\$5,079 17	\$2,244 90	\$4,069 60	\$19,380 48	\$610 02	\$1,481 83	\$1,579 31	\$1,672 18	\$62,413 63	\$62,977 81

TABLE V.

## FINANCIAL STATEMENT—LOWELL WATER WORKS, 1898.

## SUBDIVISION "WATER WORKS SUPPLIES" FROM TABLE II.

Pumping Station, No. 1, supplies.....	\$ 852 85
Pumping Station, No. 2, supplies.....	1,049 14
Pumping Station, No. 3, supplies .....	1,294 81
Pumping Station, No. 4, supplies.....	421 03
Iron pipe and specials.....	3,615 22
Hydrants.....	1,233 64
Gates and valves.....	943 75
Service pipe.....	1,856 95
Pig lead.....	438 00
Meters.....	5,673 54
Sidewalk boxes.....	610 00
Machinery and tools.....	461 16
Stationery and printing.....	479 15
Miscellaneous stock.....	2,003 29
Brass castings.....	952 79
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Total.....	\$21,885 32

TABLE VI.

## FINANCIAL STATEMENT—LOWELL WATER WORKS, 1898.

## DETAIL OF "PRINCIPAL AND INTEREST" FROM TABLE II.

## WATER LOAN BONDS:

Coupon No. 11, May, 1896,	2, at 20....	\$ 40 00	
No. 12, Nov., 1896,	4, at 20 ...	80 00	
No. 13, May, 1897,	6, at 20....	120 00	
No. 14, Nov., 1897,	9, at 20....	180 00	
No. 15, May, 1898, 987,	at 20....	19,740 00	
No. 16, Nov., 1898, 946,	at 20....	18,920 00	
		<hr/>	\$39,080 00

## HIGH SERVICE LOAN:

Coupon No. 33, May, 1898,	15, at 100....	\$1,500 00	
No. 34, Nov., 1898,	15, at 100....	1,500 00	
		<hr/>	3,000 00

## NOTES:

Lowell Inst. for Savings, 6 mos., \$24,000.00	}	\$ 840 00	
6 mos., 18,000.00			
1 year, 35,000.00...		1,225 00	
1 year, 41,000.00...		1,640 00	
1 year, 50,000.00...		2,000 00	
		<hr/>	5,705 00

## COMMONWEALTH OF MASS.:

1 year, \$65,000.00...	\$2,600 00	
	<hr/>	2,600 00
		<hr/>
		\$50,385 00

## PRINCIPAL PAYMENTS:

Engine Loan...	\$ 6,000 00	
Driven Well Loans...	10,000 00	
Driven Well Loans...	4,100 00	
Driven Well Loans...	5,000 00	
Driven Well Loans...	5,000 00	
	<hr/>	\$30,100 00
		<hr/>
		\$80,485 00

## TABLE VII.

## FINANCIAL STATEMENT—LOWELL WATER WORKS, 1898

## MAINTENANCE AND CONSTRUCTION STATEMENT.

## MAINTENANCE

## PAID FOR LABOR:

Salary President and Superintendent .....	\$ 2,200 00
Office and Inspectors.....	8,766 33
Pumping Stations.....	16,537 86
Reservoir.. ..	610 02
Meter Work.....	2,497 80
General Maintenance.....	20,959 79

## PAID FOR MATERIAL:

Output as per Stock Book.....	2,610 73
Interest.....	50,385 00
General Expense.....	1,619 48
Stable.....	1,209 21
Machinery and Tools.....	461 16
Pumping Station Supplies.....	3,617 83
Coal.....	19,685 25
Stationery and Printing.....	479 15

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Total..... \$131,639 61

## CONSTRUCTION.

## PAID FOR LABOR:

Extension, Construction and New Services.....	\$ 9,169 65
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## PAID FOR MATERIAL.

Output as per Stock Book.....	10,063 75
Payment on Loans.....	30,100 00
Land.....	5,010 97
Pipe in Gallery.....	1,332 89
Grading and Fencing.....	2,045 43

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Total..... \$57,722 69



# Superintendent's Report.

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LOWELL, MASS., Jan. 2, 1899.

*To the Lowell Water Board:*

Gentlemen,—Complying with the City Ordinances, I herewith present for your consideration the report of the Superintendent of Water Works for the year 1898.

All of the improvements and extensions voted for by Your Honorable Board during the year have been completed, excepting a short extension on Princeton Street, which was held back at the request of the owner of the house, who applied for the same.

Among the improvements made, probably the most important was the extension of the 24-inch Boulevard main through the Filter Gallery. This work, which was begun April 27th and finished June 15th, at a cost of \$5,335.08 (including pipe which was purchased in 1897), is chiefly valuable

because it enables the Department to discontinue the use of water from the Filter Gallery when not needed. It does not, however, involve the abandonment of the Gallery as a source of supply as some people claim, nor will it impair its efficiency or interfere with its use, when such use becomes necessary or desirable. That is to say, the pipe is so laid as not to come in contact with the filtering surface, or to contract the filtering area.

To describe: When the 24-inch main from the Boulevard Wells was first laid, it projected about three feet inside the westerly end of the gallery and four feet above the bottom. At this point the new pipe was connected and continued on a straight grade along the northerly side of the gallery 1320 feet to an opening in the Inlet Chamber wall, the bottom tread of which was nine inches above the bottom of the gallery. The final connection was made here by means of an iron casting specially designed for the purpose. The pipe rests on brick masonry piers built every ten feet on the old brace stones in the bottom of the gallery. About 3200 feet of copper wire, size 01, was used in securing the pipe on the piers to guard against their floating in case they became empty while the gallery was full. Twenty-four thousand bricks and sixty-five barrels of Portland Cement were used in the construction of the piers,



A 24 x 24 x 24-inch cast iron tee was set in the line opposite the Filter Basin with a view of connecting it independently of the gallery at some future time.

The weight of the pipe used on the extension was 200 lbs. per ft., or 2400 lbs. per 12 ft. lengths. All of it had to be lowered into the gallery through the bulkhead at the gate house, and from there floated to position ready for laying. This was made practicable by bolting to the open ends of each pipe tight-fitting wooden heads. After the pipe was all floated into place in order to lay the same and build the piers, continuous pumping had to be resorted to, to keep the water in the gallery sufficiently low. This was successfully accomplished by a 6-inch Centrifugal pump and an electric motor running night and day, pumping at the rate of 500,000 gallons per 24 hours. Both of these machines were bought for that purpose, and are now stored for future use. In addition to the opening in the Inlet Chamber wall used for the connection of this main, there is another of the same size. Both of these were originally used to accommodate the flow of water from the gallery, and were controlled by sluice gates set in the down stream side of the wall and operated from the floor of the gate chamber. Now one is utilized for the Well water and the other for the Gallery. A sluice gate, with a float at

tached, designed to work automatically, but which never did, was removed to allow for the connection of the 24-inch pipe.

On October 28th, four months after the work was completed, the water was drawn off the gallery and the pipe, piers, etc., inspected, when everything was found in first rate condition. At the same time a careful examination of the Conduit and Tunnel was made. No deterioration was apparent as compared with the last examination and no more leaks were discovered than previously. Thinking it might be interesting to know the precise quantity of leakage into the Conduit, advantage was taken of the fact that the Gallery and Well water was shut off and the amount measured by catching the water in a pail where it discharged in the terminal chamber. The result obtained was 65 gallons per minute or 93,600 gallons per day. As the season about that time was very rainy and the ground consequently contained considerable moisture, the figures given are probably not far off the maximum yield.

#### GRADING AND FENCING LAND NEAR CONDUIT.

About four thousand three hundred and eighty-three cubic yards of earth filling were used in grading and filling the several lots of land over the Conduit, recently purchased, together with the

land surrounding the Inlet Chamber house as follows :

Land between Gershom and Gardner Ave.,	660 cu. yds.	
“ “ Moody St. and Sarah Ave.,	3,068	“
Bodwell Homestead lot,	100	“
Inlet Chamber lot,	555	“

On the northerly and easterly lines of the Bodwell Land 490 perch of stone were used in constructing a retaining wall. The stone for this wall and the sand used for filling were procured in the neighborhood without expense, save for hauling.

Fences were built on lines of the following lots: Bodwell Homestead lot, land between Gershom and Garden Avenues, land between Moody Street and Sarah Avenue, Filter Basin lot, land on Varnum Avenue opposite Inlet Chamber, west line of Boulevard land above Pumping Station No. 4; whole amount of fence built, 3,480 ft., of which all but 165 ft., were picket fence. Two coats of red paint were given all this new fence and also the old fence at the Inlet Chamber.

The total cost of fencing, grading, etc., the foregoing lots, including the bank wall on the Bodwell lot, together with rebuilding the old fence on the top line of the wall, was \$5,349.97.

Some little work yet remains to be done in top dressing the Bodwell lot, otherwise everything voted regarding these premises has been attended to.

Stone bounds were set during the year on the corners of all lots owned by the Department, not heretofore so bounded, the same involving, as it did, a new survey of such land.

Signs marked "Lowell Water Works" were also placed on the different pieces of land belonging to the Department.

#### EXTENSIONS, GATES, HYDRANTS, ETC.

Accompanying this report is a schedule containing the location and size of all extensions of main pipe laid, and number, size and location of all hydrants and gates set during the year. These figures show that 14,046 feet of cast iron pipe was laid, of which 712 feet was replacing smaller pipe in Rogers and Tremont Streets. Thus making a total, of in round numbers, of 124 miles now in use.

Forty-six new gates were set, making a total of 1,144 gates, and twelve additional public hydrants were added, making a total of 1,123 hydrants in use, not counting hydrants for private purposes.

The figures for pipe laid include pipe used for Fire Services as follows:

Tremont and Suffolk Store-House, Cabot Street.  
Tremont and Suffolk Mills, Cabot Street.  
Tremont and Suffolk Mills, Tremont Street.  
Lowell Hosiery Mill Yard.  
Belvidere Woolen Mills, No. 2, Lawrence Street.  
Stirling Mills, Lawrence Street.  
Faulkner's Mills, Lawrence Street.  
Barker Manufacturing Co., Middle Street.  
Varnum School, Sixth Street.  
American Safety Tread Co., Perry Street.

The total length of pipe laid the past year was less than the previous year and should be still further reduced this year.

#### SERVICES.

Only 165 new services were laid during the year amounting to 6,534 feet of pipe against 350 the previous year or 12,330 feet of pipe. This is a remarkable falling off in service work, remarkable not alone in comparison with 1897 but because it is the smallest number of services laid in any one year since the construction of the Works.

## NEW SERVICES.

23	5-8-inch Lead Pipe	.	.	697 feet
37	3-4-inch Lead Pipe	.	.	1,244 feet
4	1-inch Lead Pipe	.	.	128 feet
96	3-4-inch Iron Lead Lined	.	.	3,502 feet
2	1-inch Iron Lead Lined	.	.	244 feet
2	1 1-2-inch Iron Lead Lined	.	.	504 feet
1	2-inch Iron Lead Lined	.	.	215 feet
<hr/>				<hr/>
165	Total laid in 1898.	.	.	6,534 feet

Amount previously laid	.	.	399,232 feet
Total now laid	.	.	405,766 feet
Total services laid	.	.	11,059 feet
Total cut off at main	.	.	708 feet
Total reconnected	.	.	45 feet
Total now in use	.	.	10,396 feet

## SERVICES CHANGED.

No.	Kind	Changed to
43	3-4-in. iron	.
30	3-4-in. iron	.
2	3-4-in. iron	.
85	3-4-in. iron	)
2	3-4-in. iron	)
1	3-4-in. iron	)
4	3-4-in. iron	1
1	3-4-in. lead	)
5	1-in. iron	2
4	1-in. iron	.
1	1-in. iron	)
2	1-in. iron	1
12	1-in. iron	1
7	1-in. iron	.
11	1-4-in. iron	i
11	1-2-in. iron	)
11	1-2-in. iron	)
11	1-2-in. iron	1
11	1-2-in. iron	3
1	2-in. iron	)
215	Total	3

## METERS.

Four hundred and eighty-two (482) meters were added during the year, making a total of 4,866 now in use. This is only 47 per cent. of the total number of services, yet yields 54 per cent. of the earnings of the Department or \$108,757.83 against \$89,820.63 accruing from unmetered water. These figures speak for themselves and are especially significant when considered in connection with the greater quantity of water delivered to consumers who are charged schedule rates. In other words, if the total quantity of water consumed was paid for at the regular price for metered water, viz., 14 cents per 100 cubic feet, less 10 per cent. discount, the income of the Department for water would be \$412,368.65 instead of \$194,291.30, the actual receipts for the past year.



## METERS RUNNING January 1, 1899.

Sizes	5-8 in.	3-4-in.	1-in.	<sup>1</sup> 1-2-in.	2-in.	3-in.	4-in.	6-in.	Total
Desper - - -	60	31	8	..	..	..	..	..	99
Crown - - -	1965	1488	264	11	14	2	5	2	3751
Worthington . -	207	28	52	64	32	7	3	..	393
Duplex - - -	7	10	7	..	..	..	..	..	24
Ball and Fitts - -	2	..	..	..	..	..	..	..	2
Fitts Rotary - -	1	..	..	..	..	..	..	..	1
Frost - - -	4	6	1	..	..	..	..	..	11
Thomson - - -	6	20	3	..	..	..	..	..	29
Gem - - -	..	..	..	..	5	..	2	1	8
Metropolitan - -	..	2	..	..	..	..	..	..	2
Trident - - -	66	19	1	..	..	..	..	..	86
Nash - - -	62	63	42	..	..	..	..	..	167
Lambert - - -	22	51	7	..	..	..	..	..	80
Niagara - - -	1	1	..	..	..	..	..	..	2
Hersey - - -	78	34	3	..	..	..	..	..	115
Empire - - -	50	25	1	..	..	..	..	..	76
Westinghouse - -	..	1	..	..	..	..	..	..	1
Columbia - - -	2	..	..	..	..	..	..	..	2
Union - - -	14	1	..	1	..	..	..	..	16
Total - - -	2547	1780	389	76	51	9	10	3	4865

## PRIVATE METERS RUNNING January 1, 1899.

Size - - - . -	3-8-in.	5-8-in.	3-4-in.	1-in.	2-in.	Total.
Desper - - - - -	--	1	3	1	--	5
Worthington - - -	--	--	--	1	2	3
Crown - - - - -	1	29	22	2	--	54
Duplex - - - - -	--	1	--	--	--	1
Thomson - - - - -	--	--	1	--	--	1
Hersey - - - - -	--	2	--	--	--	2
Nash - - - - -	--	11	2	--	1	14
Frost - - - - -	--	2	1	--	--	3
Empire - - - - -	--	2	--	--	--	2
Trident - - - - -	--	1	--	--	--	1
Lambert - - - - -	--	2	--	--	--	2
Total.	1	51	29	4	3	88

New meters - - - - -	484
Meters condemned - - - - -	39
Meters cleaned and repaired - - - - -	580
Meters frozen and burst - - - - -	57
Meters discontinued - - - - -	6
Meters set for private use - - - - -	7
New meters set in place of old ones condemned - - - - -	43

## MAINTENANCE.

While the construction work of the Department is liable to decrease, as can be seen by the number of extensions and services laid last year, as compared with previous years, the ordinary maintenance work of a plant like the Lowell Water Works must naturally increase year by year. When the old valve boxes decay and become dangerous to public travel, they have to be renewed. Iron service pipes in time yield to corrosion, rendering them unfit for use and they have to be replaced with new. Occasionally from wear and tear valves and hydrants break down. Cast iron mains also deteriorate after the lapse of years and with an increase in the population to be supplied, they frequently have to give place to larger mains; every increase in the territory to be piped for distributing water adds to the cost of operation and maintenance. Another cause of expense is the work necessary for preserving the purity of the water and guarding against its pollution. In this direction the utmost vigilance is at all times imperative to see that no opportunity is allowed for the contamination of water in the wells, the mains or the reservoirs; the wells should be cleaned every year and the mains blown out regularly.

Progress in the manufacture of pumping machinery and other mechanical appliances compel, in

the interest of economy, the substitution of new machinery and new tools. Of course, experience and study have developed new ideas in the Water Works construction tending to greater durability in the materials used, which thereby will undoubtedly have the effect of lessening the outlay for maintenance. Iron valve boxes are now used instead of wooden boxes, lead or lead-lined iron pipes have taken the place of plain iron pipes. Flush hydrants, with their necessary wooden boxes, have given way to post hydrants, and when street mains are now laid the probable future needs of the district to be supplied is anticipated and larger pipes as a rule are used. But probably the greatest strides in the line of economy have been made in pumping machinery.

#### PUMPING STATIONS AND PUMPING.

The controlling idea in the management and conduct of the different pumping plants of this Department during the year was to so regulate their operation as to give the consumers the least possible reason for complaint regarding the quality of the water, at the same time devising ways and means to reduce the cost of pumping to the lowest possible point without neglecting any needed repairs or reasonable improvements.

At Pumping Station No 1, the High Duty Worthington Pump ran 282 days, pumping

988,451,625 gallons; the Low Duty Worthington ran 39 days, pumping 131,679,940 gallons; the old Morris Engine was not called upon for any service during the year. So much for the Low Service. The High Service Pump ran 273 days and pumped 40,084,506 gallons.

The High Duty Worthington, which the foregoing figures show, did nearly all the pumping, for the low service was a little off in its work for a time, owing to the leakage of air by the piston of the accumulator. Taking it apart an examination found one of the packing rings on the piston broken; this was replaced by a new one and an additional ring was also fitted to the piston, making four instead of three, as originally. Since these repairs were made the working of the pump has been satisfactory. While the Low Duty Worthington was running, one of the 4-inch pump valve seats came out of place; this was caused by the lead which formed a joint around it becoming loose. It was fixed temporarily at the time of its occurrence with cold lead, and later a new lead joint was run around it and set up carefully. Other minor repairs were made on the High Service pump, the feed and air pumps. The feed pumps were also removed from the basement of the engine room to the boiler room where they will be more directly under the eye of the firemen. A new iron ladder, 23 feet long, was placed,

extending from the floor of the engine room to the bottom of the main pump well, the old wooden ladder, formerly used having become unsafe.

Total quantity of water pumped

at this station . . . . . 1,120,131,565 galls.

Total cost of pumping per million gallons, \$ 8 18

Total cost of pumping per million galls. H. S. 11 75

At Pumping Station No. 2 a full new set of piston heads were made at the Department Shop for the water ends of the Dean Pumps; also a new set of sleeves were purchased of the Dean Steam Pump Company for the same pumps. Only one of the pumps, however, was furnished with these heads and sleeves; the other must wait until a more favorable time for shutting down.

Total quantity of water pumped

at this station, . . . . . 816,455,736

Total cost of pumping per million gallons, \$14 11

At Pumping Station No. 3 the buildings and machinery are in about the same general condition they were a year ago. Very little repairs were made, in fact, it would be doubtful wisdom to contract any expense in that direction at this station; for, although the equipment is quite inferior, the prospects now are that it will only run occasionally, and then only in an emergency. The

Wells on Section C, fifty in number, were thoroughly cleaned by scraping, tripping and pumping each individual well.

An effort was made to shorten the suction for the condenser pump by excavating a trench from the brook to within a hundred feet of the station. It was partially completed when the water became too high for the workmen. Work will be resumed on it again when the brook is low enough. Wooden shutters are made for the windows of this station with bolts to fasten them on the inside when the Station is not in use. The past year it was shut down and closed 171 days. In order that its use might be still further discontinued, experiments were made to ascertain the practicability of drafting water from the wells at this plant with the pumps at No. 2 station, a distance of 5,300 feet. For this purpose a 12-inch connection with a 12-inch gate was made between the 20-inch force main from No. 3 station and the suction pipe at No. 2 station. The result was successful to the extent that with the 12-inch connection opened the vacuum gauge on the suction pipe at No 3 showed a vacuum of from 7 to 10 inches, while the pumpage at No. 2 was increased at the rate of 500,000 gallons every twenty-four hours. At a time, too, when the water in the wells was comparatively low. A week's run was made with this connection open, but after the first

day considerable air began to manifest itself, at first only slightly interfering with the working of the pump but gradually growing worse until it was finally necessary to close the connection. This difficulty with air was attributed to the fact that the water, in its way from the wells to the pumps passed a roundabout and tortuous course through the suction pipe and pumps at Station No. 3 before it entered the long line of 20-inch pipe, thus increasing the possibility of air-leaks, not to mention the friction caused thereby.

To obviate these conditions, it was thought best to make a direct connection between the top of the receiver and the force main and acting under your authority a 20-inch connection with a 20-inch gate was accordingly made. Since this change the pumps at No. 2 Station have been able, from pumping 2,750,000 gallons per day with 27 inches of vacuum, to pump 4,000,000 gallons with 2 inches less vacuum and against greater head pump 5 gallons more of water per lb. of coal. That the success of this experiment is of great value to the Department can be appreciated when the saving in salaries is considered that would be paid for the operation of No. 3 station perpetually. It is also a benefit inasmuch as it provides for the constant use of the wells which would undoubtedly suffer if they were allowed to stand idle for a great length of time; and



another item worth considering is the fact that the ground water around the station will now be kept lower, thereby saving the interior of the station from damage and the boilers and pumps from injury caused when the water is high.

Total quantity of water pumped at this station 515,625,542 gallons.

Total cost per million gallons, \$12.20.

The condition of affairs at No. 4 Pumping Station has been greatly improved during the year. A new coal bin of 200 tons capacity was erected at the westerly end of the boiler room. This was much needed as the old bin when full could accommodate but a week's supply of coal. The grounds about the buildings were cleaned of rubbish, graded and sown with grass seed. Several trees and bushes were planted in front of the Station, and seats and bicycle racks were arranged at the easterly end of the Station for the convenience and use of bicycle riders who stop there for drinking water on their way up and down the Boulevard, and a long bar made of 2-inch pipe was set up for hitching horses.

The road approaching the Station from the Boulevard was widened and graded and the slopes sodded. The exterior of the building was newly painted, all of which has the effect of giving the place a neat and attractive appearance, making it,

without doubt, the most popular spot on the Boulevard.

Quantity of water pumped at this Station, 1,055,450,387 gallons.

Cost of pumping per million gallons, \$6.88.

The total quantity of water pumped at all Stations during the year was 3,517,663,230 gallons. Deducting from these figures the quantity pumped at Station No. 4, which has to be repumped at No. 1 Station, namely 1,065,450,387 gallons, and we get what was pumped into the reservoir or into the distributing pipes for consumption, 2,452,212,843 gallons. This is somewhat in excess of last year.

Compared with 1897, the cost of pumping shows a material reduction, viz.: \$13.99 vs. \$16.68. This lowering of the cost of pumping is due in a great measure to the closing of No. 3 Station for a considerable part of the year, and might have been still lower but for expense attending the improvements made at the various Stations, particularly at No. 4 Station, where an unusual amount of labor was performed.

All of the Stations have a large stock of coal, probably sufficient to last until April.

Cost of Pumping based on Pumping Station expenses, \$13.99.

Cost of Pumping based on Maintenance expenses,  
\$33.14.

Cost of Pumping based on Maintenance and Interest, \$53.68.

Cost of Pumping based on Total expenditures,  
\$80.52.

#### CONSUMPTION.

The quantity of water used and wasted for the year 1898 was 2,454,575,265 gallons; this is 47,332,251 gallons in excess of 1897.

The average daily consumption was 6,724,865, making a daily per capita consumption of 78 gallons.

#### MISCELLANEOUS.

Pursuant to the vote of Your Honorable Board, the Drinking Fountain located at the entrance to Fort Hill Park was removed and placed at the junction of Gorham and Carlisle Streets.

Fifteen tons of hay were cut from the Reservoir lot and land on the Boulevard beyond the Pumping Station. Several small leaks were reported and repaired during the year, but none of a serious nature.

Owing to the widening of Andover Street, all of the hydrants on the street east of Nesmith Street had to be relocated, and as those in use there were old style and badly worn, they were replaced by new Ludlow Post Hydrants. The ser-

vice and gate boxes on the south side of the street were also moved; most of them requiring renewal.

CONCLUSION.

In concluding, I take this opportunity of expressing my appreciation of the cordial support given me by President Weaver and the members of the Board during the year, and to acknowledge the efficient co-operation of Secretary Crawford. I also desire to bear testimony to the valuable aid rendered to the Department by W. F. Sullivan of the City Engineer's Office.

Respectfully submitted,

ROBERT J. THOMAS,

Superintendent.

## LOW SERVICE.—WATER PIPES LAID IN 1898.

STREETS.	BETWEEN WHAT STREETS.	Length in feet.					Total.
		4-in.	6-in.	8-in.	10-in.	12-in.	
Alken .....	Between Hall and Perkins .....			337			337.0
Andover .....	Service to Locks and Canals Bld'g	18					18.0
Andover .....	Easterly to Town Line.....		418				418.0
Ayer Ave .....	Easterly to Quebec st.. .....		205				205.0
Barnaby .....	Extended northerly.....		48				48.0
Belrose Ave ..	Between Hanks st. and Waverly av		390				390.0
Burgess.....	Easterly to School st.....		215½				215.5
Cabot .....	On fire service to T & S storehouse		16½				16.5
Cabot .....	On corp. connection opp. Gore st					11	11 0
Chelmsford ...	Extended southerly to Stevens st			436			436.0
Chestnut .....	Nesmith and Park sts.....		398				398.0
Coburn Ave...	Westerly to Stevens.....		212				212.0
Crowley.....	Extended southerly.....		63				63.0
Dane .....	Westerly to Fletcher st.....		208½				208.5
Fernald .....	Extended southerly.....		3				3.0
Fourth Ave...	Easterly to Moody st.....			261			261.0
Grove .....	Easterly to Loring st .....		168				168.0
Hanks.....	Southerly to Rogers st.....		18				18.0
Hanks.....	Rogers and Belrose ave.....		377				378.0
Hawthorne ...	Extended southerly.....		52				52.0
Lawrence.....	Sherman st and Belvidere mill No. 2 (Private).....			208			208.0
Leyden .....	Southerly from Andover st.....		66				66.0
Liberty . ....	Between Warwick and Pine sts...		136½				136.5
Livingston Av	Extended southerly.....		345				345.0
Lowell H'slery	Fire service in yard (Private).....		137½				137.0
Magnolia . ...	Southerly from Varnum ave.....		350				350.0
Middle .....	Fire service to H R Barker M'f'g Co		37½				37.5
Newell ....	Extended easterly.....		170				170.0
Norwood.....	Southerly from Midland st.....		189				189.0
	Carried forward .....	18	4224	1242		11	5495.5

LOW SERVICE.—WATER PIPES LAID IN 1898.—*Continued.*

STREETS.	BETWEEN WHAT STREETS.	Length in feet.					Total.
		4-in.	6-in.	8-in.	10-in.	12-in.	
	Brought forward.....	18	4224	1242		11	5495.5
Parker .....	Westerly to Plain st .....		284				284.0
Penn Ave.....	Southerly to Ayer ave.....		378				378.0
Pentucket.....	Southerly from Andover st.....		42½				42.5
Perkins .....	Across Alken st.....				53		53.0
Perry .....	Southerly to Sherman st.....			5-3			583.0
Perry .....	Fire service to Am. Safety Tread Co		14				14.0
Plain .....	Easterly to Penn ave .....		255				255.0
Quebec .....	Southerly to Ayer ave.....		93				93.0
Queen.....	Southerly to Westford st .....		140				140.0
Rogers .....	High and Nesmith.....				1419		1419.0
Sanders Ave..	Extended southerly ....		48				48.0
Sherman ...	Fire service to Sterling and Faulk- ner's (Private).....		243	541	815		1599.0
Sixth.....	Fire service to Varnum school....	58½					58.5
Starbird... .	Extended northerly....		48				48.0
Stevens .....	Extended to Chelmsford st .....			356			356.0
Stevens .....	Extended southerly from Jenness			522½			522.5
Tremont .....	From 20-inch pipe s'ly to T & S storehouse..					266	266.0
Tremont .. .	Corp. connection to T & S mill.....					7	7.0
Waterford ...	Extended easterly.....		234				234.0
Waverly Ave..	Rogers and Belrose ave.....		423				423.0
Westford .....	Westerly to terminus near Pine st			816			816.0
Westford .....	Westerly from Pine st..			179			179.0
Hydrants .....	.....		167½	16½			184.0
	Laid in 1898.....	76½	6594	4256	2287	284	13497.5
	Less taken out Rogers and Tre- mont sts.....						712.0
	Total .....						12,785.5

## HIGH SERVICE—WATER PIPES LAID IN 1898.

STREETS.	BETWEEN WHAT STREETS.	Length in feet.					Total.
		4-in.	6 in.	8-in.	10-in.	12-in.	
Belmont Av. .	Mansur and Wyman sts .....						228.0
Wentworth Av.	Extended northerly.... ..						371.0
Wyman .....	Westerly from Belmont ave .....		24				8.0
Wyman ...	Fire service to B F Butler's stable						197.0

Brought forward.....	12,785.5 feet
Low service laid previous to 1898.....	610,497.8 "
<hr/>	
Total low service to January 1, 1899....	623,283.3 "
Total high service to January 1, 1899.....	36,317.0 "
<hr/>	
Total high and low service to January 1, 1899.....	659,600.3 "
Total in miles, 124.922.	

## LOW SERVICE—LIST OF STOP GATES SET DURING 1898.

STREETS.	LOCATION.	INCHES.				
		6 in.	8 in.	10 in.	12 in.	20 in.
Alken . . . . .	13.7 feet south of north line Alken street, on line Hail street. . . . .					
Andover . . . . .	On service to L. & C.'s premises, 52 feet west of line of A. E. Rose's, 34.8 feet north of south Andover street (under track). . . . .					
Andover . . . . .	On service to L. & C.'s premises, 17 feet south north line of Andover street, 11 feet east of line D. W. C. Farrington's . . . . .					
Andover . . . . .	20 feet south of north line Andover street, 37.6 east of east line Wenworth ave. . . . .					
Belvidere Woolen Mill, No. 2 . . . . .	20.6 feet north of mill, 5 feet west of west line 1 fence street. (Private) . . . . .					
Bridge . . . . .	15 feet west of east line Bridge street, 17.9 north of north line Merrimack square. (Chas. old gate) . . . . .					
Burgess . . . . .	12 feet south of north line Burgess street, 13.7 east of west line School street . . . . .					
Cabot . . . . .	Fire service to Tremont and Suffolk storehouse 12.3 feet south of north line Cabot street, 10.7 feet east of east line Cheever street . . . . .					
Cabot . . . . .	Corporation connection to L. & C.'s pipe, 16.0 east of west line Cabot street, 10.7 feet south north line T and S storehouse . . . . .					
Chelmsford . . . . .	16.8 feet east of west line Chelmsford street, 12 feet north of south line driveway to City Pa . . . . .					
Chestnut . . . . .	15.1 feet north of south line Chestnut street, west line Park street . . . . .					
Coburn Ave . . . . .	10 feet south of north line Coburn Avenue, on east line Stevens street . . . . .					
Dane . . . . .	7.6 feet south of north line Dane street, 15.3 feet west of east line Fletcher street . . . . .					
Fourth Ave . . . . .	14.6 feet north of south line Fourth avenue, on west line Moody street . . . . .					
Grove . . . . .	12 feet south of north line Grove street, on west line Loring street . . . . .					
Hanks . . . . .	12 feet west of east line Hanks street, on south line Rogers street . . . . .					
Lawrence . . . . .	On 10 inch fire service to Sterling mill, 12 feet north of south line Sherman street, 12.6 feet west of east line Lawrence street (Private) . . . . .					
Lawrence . . . . .	Check valve, on 10 inch fire service to Sterling mill, 12 feet north of south line Sherman street, 11 feet west of east line Lawrence street (Private) . . . . .					
Leyden . . . . .	15 feet east of west line Leyden street, on south line Andover street . . . . .					



LOW SERVICE—LIST OF STOP GATES SET DURING 1893.—*Continued.*

STREETS.	LOCATION.
Lowell Hosiery Co	Kennedy gate in middle of mill yard, 59 feet of Broadway building.....
Magnolia Ave .....	12 feet west of east line Magnolia street, on line Varnum avenue.....
Middle.....	On fire service to H. R. Barker Mfg. Co., 61 east of east line building, 28.7 feet north of south line, Middle street.....
Norwood ... ..	12 feet east of west line Norwood street, on line Midland street.....
Penn Ave.....	14.8 feet east of west line Penn avenue, on line Plain street.....
Pentucket .....	13 feet west of east line Pentucket street, on line Andover street.....
Perry .....	On fire service to Am. Safety Tread Co., 1 east of building, 7½ feet south of north buildings .....
Pumping Sta. No. 3	30-inch gate between force main and receiver
Queen.....	17.3 feet east of west line Queen street, on line of Westford street .....
Robinson .....	3 feet south of north line Robinson street, 130 west of west line Robinson's court.....
Rogers .....	16.2 feet south of north line Rogers street, 1 west of east line High street .....
Rogers .....	28.2 feet east of west line Rogers street, on line Waverly avenue .....
Sixth .....	Fire service to Varnum school, 14.6 feet north of south line Sixth street, 35.3 feet east of east Myrtle street .....
Sterling Mill.....	On fire service east of mill. Private. (See plan)
Sterling and Faulkner's Mills.....	Fire service in mill yard. Private. (See plan)
Sterling and Faulkner's Mills ....	Check valve on fire service in mill yard. Private (See plan) .....
Stevens .....	28 feet south of north line Stevens street, on line Chelmsford street .....
Tremont .....	16.6 feet west of east line Tremont street, on line passageway. Changed from 6-inch to 12
Tremont ..	22.2 feet west of east line Tremont street, 3.6 north of north line T. & S. storehouse.....
Waverly Ave . ....	12 feet east of west line Waverly avenue, on south line Rogers street .....
Westworth Ave....	13.3 feet east of west line Westworth avenue, on south line Andover street (Changed) .....

# LOW SERVICE—LIST OF HYDRANTS SET DURING THE YEAR 1898.

STREETS.	LOCATION.
Andover .....	Northerly side on terminus near Town line.
Belrose Ave.....	Southerly side, 3 feet west from Waverly avenue.
Bridge .....	Easterly side, near Mass. Cotton mill gate.
Bridge .....	Westerly side, 60 feet south of Central bridge.
Chelmsford .....	Easterly side, just north of Stevens street.
Faulkner's Mills....	Two-way hydrant east of mill. (Private).
Faulkner's Mills....	Two-way hydrant east of mill. (Private).
Faulkner's Mills....	Two-way hydrant east of mill (Private).
Faulkner's Mills....	Four-way hydrant west of mill, on canal bank. (Private).
Fernald .....	Flush hydrant on end of 6-inch pipe.
Hanks ... ..	Easterly side, 3 feet south of Rogers street.
Lowell Hosiery Co	Kennedy hydrant in middle of mill yard. (Private).
Manchester .....	Flush hydrant, northerly side, on pipe terminus.
Nasmith.....	Easterly side, opposite Waverly avenue.
Newell .....	Northerly side, on terminus.
Penn Ave.....	Westerly side, 48 feet south of Plain street.
Perkins .....	Westerly side, just north of Aiken street.
Sterling Mills.....	Two-way hydrant east of mill. (Private).
Sterling Mills.....	Three-way hydrant east of mill. (Private).
Sterling and Faulk- ner's Mills.....	Four-way hydrant between mills on canal bank. (Private).

# HIGH SERVICE—LIST OF STOP GATES SET DURING THE YEAR 1898.

STREETS.	LOCATION.	4-in.	6-in.	8-in.	10-in.	12-in.	20-in.
Belmont Ave.....	13.6 feet east of west line Belmont avenue, on north line Mansur street.....		1				
Wyman .....	On fire service to B. F. Butler's stable, 5 feet south of north line Wyman street, 13 feet east of west line Belmont avenue .....	1					

# HIGH SERVICE—LIST OF HYDRANTS SET DURING THE YEAR 1898.

STREET.	LOCATION.
Wyman .....	Northerly side, opposite Belmont avenue.

# LEAD LINED PIPE LAID DURING THE YEAR 1898.

STREETS.	LOCATION.	1½-in.	2-in.	Totals.
Bagley Ave.....	Off Foster street.....		150½	150.5
Malden Lane... ..	Northerly from Market street.....	91½		91.5
New Nichols .....	Southerly from Westford street.....		236	236.0
Sherman .....	Lawrence street, easterly to Sterling Mill.....	480		480.0
	Total. ... ..	571½	386½	958.0

## STOCK ON HAND JAN. 1, 1898.

SIZE.	2-in.	4-in.	6-in.	8-in.	10-in.	12-in.	16-in.	20-in.	24-in.	30-in.
Lengths of Pipe -	--	78	140	--	20	13	29	20	31	20
Sleeves - -	--	--	12	28	8	13	7	3	4	10
Caps - - -	--	60	31	66	--	12	2	1	1	--
Plugs - - -	--	10	96	35	--	--	1	--	--	--
Curves, 1-4 -	--	7	4	16	10	19	3	--	--	--
Curves, 1-8 -	--	1	32	6	8	2	9	5	4	--
Curves, 1-16	--	3	5	5	--	8	7	13	1	2
Offsets - -	--	--	6	--	--	--	--	--	--	--
Gates - - -	--	--	9	6	3	--	1	--	--	--
Smith Gates -	1	6	6	2	--	--	--	--	--	--

## PROPERTY AND TOOLS AT SHOP, HAMPSHIRE STREET.

One 8x10 plain slide valve engine, 1 10-foot engine lathe, 1 7-foot engine lathe, 1 6-foot brass finishing lathe, 1 5-foot speed lathe, 1 shaper, 1 upright drill, 1 emery wheel, 1 grindstone, 2 soldering furnaces, 1 large end chuck, 2 independent chucks, 2 drill chucks, 10 lathe dogs, 20 reamers, 10 twist drills, 8 flat drills, 12 flat chucking drills, 42 turning tools, 10 steel arbors, 2 reamers for Desper meters, 21 taps, 3 tap wrenches, 1 hand vise, 4 vises, 2 pipe vises, 1 wagon vise, 1 large platform scales, 3 small platform scales, 1 Smith tapping machine, 1 shaft hanger, 44 tools for brass lathes, 12 sets, 13 cast iron chucks, 1 set hand chasers, 1 set hand tools, 1 set broachers, 25 tools for brass work, 1 set wood patterns for 1-inch sidewalk cocks, 1 set 1-inch Corporation cocks, 1 wood pattern complete for 2-inch plug cock, 1 wood and two brass patterns for handles 1-inch cock, 1 gate of 4 brass patterns for  $\frac{3}{4}$  sidewalk cocks, 1 gate of 4 brass patterns for  $\frac{3}{4}$  Corporation cocks, 1 gate of 4 brass patterns for plugs for  $\frac{3}{4}$  sidewalk cocks, 1 gate of 4 brass patterns for plugs for cellar cocks, 1 gate of four brass patterns for tail pieces for  $\frac{3}{4}$  cocks, 1 gate of 4 brass patterns for smooth tail pieces, 1 gate of 4 brass patterns for  $\frac{3}{4}$ -inch cock washers, 1 gate of four brass patterns for nuts for  $\frac{3}{4}$ -inch cocks, 1 gate of 4 brass patterns for  $\frac{3}{4}$ -inchx $\frac{1}{2}$ -inch couplings, 1 gate of 4 brass patterns for  $\frac{3}{4}$ -inch thimbles, 2 large wood patterns for heads of pumps, 1 wood pattern for packing box to High Service engine, 2 large wood patterns for nuts to plunger rod for pumps, 1 Gow meter testing machine, 1 platform scales with tank for testing meters, 12 Stilson wrenches, 9 S wrenches, 13 hydrant wrenches, 8 post-hydrant wrenches, 8 gate wrenches, 16-inch Kennedy valve, 1 gas radiator, 4 pipe hangers for East Merrimack Street bridge, 4 tapping machines and rubbers, 6 taps and drills, 3 tap wrenches, 1 set plumbers' tools, 2 naphtha furnaces, 1 pair round nose pliers, 2 soldering irons, 3 screw drivers, 15 files 2 dust pans, 4 oil cans, 1 large oil can, 1 set of bits, 1 set of chisels, 1 belt punch, 1 set steel figures, 1 naphtha can, 2 hack saws, 1 pair scissors, 1 pair snips, 1 saw set, 1 desk, 2 gate plans, 1 marlin spike, 2 naphtha lamps, 1 Lowell Water Works seal, 1 set of tools for sealing fire services, 2 tool bags, 1 step ladder, 1 map of water mains, 1 clock, 1 chair, 3 stools, 2 floor brushes, 1 mirror, 1 can of glue, 1 waste can, 1 lawn mower, 1 piper's bench, 6 lengths

of 2½-inch hose, 1 nozzle, 2 dutchmen, 6 pounds iron wire, 10 pounds brass rod, 5 pounds copper wire.

#### PROPERTY AT SUPERINTENDENT'S OFFICE.

Three desks, 3 chairs, 1 set of drawers and bookcase, 1 small bookcase, 1 Howard electric clock, 1 letter press, 1 gate plan, 2 diagrams, 1 picture, 4 bill files, 1 water gauge, 2 inkstands, 1 feather duster, 1 set of ward maps.

#### PROPERTY AND TOOLS AT TOOL HOUSE.

Twelve diamond points, 150 feet tape line, 3 flush hydrant wrenches, 7 picks, 33 lanterns, 78 round pointed shovels, 12 square pointed shovels, 6 long handle shovels, 15 iron mauls, 18 wooden maul, 5 paving mauls, 4 hand saws, 50 feet 1-inch rubber hose, 11 striking hammers, 14 hoes, 2 iron rakes, 5 ladles, 13 gate wrenches, 3 iron blocks and falls for derrick, 3 wooden blocks and falls for derrick, 7 tag ropes, 7 rock chains, 8 sidewalk wrenches, 37 pick handles, 7 steel bars, 20 pounds clay, 2 hatchets, 1 trowel, 2 galvanized iron pails, 4 old pails, 4 dippers, 7 caulking hammers, 9 cold chisels, 7 sets, 4 yarning irons, 3 wedges, 5 clamps, 1 6-inch clip, 11 oil cans, 1 oil tank and pump, 4 tunnels, 10 gallons of oil, 1 long chain, 1 1½x1 inch iron bushing, 50 pounds wrought iron pipe, 2 spanners, 4 post hydrant wrenches, 100 feet of line, 4 man-hole steps, 1 ¾-inch brass valve, 3 6-inch wooden plugs, 2 8-inch wooden plugs, 1 12-inch wooden plug, 1 grate for coke furnace, 5000 old bricks, 7 bridge bolts, 1 8-inch clip, 1 rubber wagon spring, 4 boundary stones, 4 derricks, 25 feet 4-inch soil pipe, 20 feet 6-inch soil pipe, 23 hydrant frames, 27 hydrant covers, 129 gate frames and covers, 2 3-foot extensions, 28 2-foot extensions, 31 extension plugs, 1 square iron gate box, 1 iron part of drinking fountain, 1 drinking fountain complete, 1½ cords of wood, 1 pipe bench, 2 saw horses, 7 wheelbarrows, 1 stove, 12 feet 6-inch stove pipe, 170 fire brick, 4 2-inch tees, 1 mortar box, ¼ barrel of red paint, ¾ barrel green paint, ¾ barrel drab paint, ½ barrel black asphalt, 3 gallons linseed oil, 2 ¾ Corporation cocks, 1 faucet, 6 paint pots, 4 odd gate tops, 3 odd bottoms, 7 gate caps, 8 screens, 2 new screens, 2 wagon

jacks, 1 carpenter's bench, 2 door hangers, 1 boat, 2 oars, 3 buck saws, 1 copper hand pump, 1 pattern for wooden gate box, 1 pattern for wooden hydrant box, 1 sand screen, 1 gravel screen,  $\frac{1}{2}$  barrel brimstone, 25 logs for blasting, 19 slings, 1 stone drag, 2 dog troughs for fountains, 7 paint brushes, 1 apron for drinking fountain, 5 bridge hangers for pipe, 3 16-inch sleeves for drain pipe, 200 feet  $\frac{3}{4}$ -inch iron cable, 2 iron hoops, 2 long handle scoops, 1 screen and frame for cellar window, 1 gallon naphtha, 2 coke furnaces, 4 lead pots, 1 iron for cant hook, 25 old doors, 3 old double windows, 15 old windows, 3 transom windows, 2 5-foot horses for painters, 2 8-foot horses for painters' staging, 4 driving mauls, 6 2-foot horses for carpenters, 1 12-foot fence gate,  $\frac{1}{2}$  keg bridge spikes, 430 feet 1-inchx6-inch spruce plank, 103 feet  $\frac{7}{8}$ -inch fine finish boards, 180 feet  $1\frac{1}{8}$ -inch fine finish boards, 270 feet  $\frac{7}{8}$ -inch Northern pine matched boards, 210 feet 2-inch maple plank, 45 cedar posts, 120 4-foot pickets, 1740 5-foot pickets, 2442 feet 2-inchx4-inch fence rails, 9716 feet 2-inch spruce plank, 1000 feet 2-inch kyanized plank, 4 steel tunnel bars, 3 fork wrenches, 5 square head sidewalk wrenches, 40 feet 4-inchx4-inch kyanized plank.

#### PROPERTY AND TOOLS AT STATION NO. 1.

Eleven wrenches for high duty Worthington, 11 wrenches for low duty Worthington, 11 wrenches for Morris engine, 2 oil dishes, 1 set oil cans, 1 oil filter, 1 work bench, 1 vise, 10 drills, 2 cold chisels, 2 bitstocks, 2 bits, 1 level, 1 keyhole saw, 1 hacksaw, 2 monkey wrenches, 3 sledge hammers, 4 socket wrenches, 1 2-foot steel square, 1 copper hammer, 2 hammers, 2 jackscrews, 1 tool cupboard, 1 set differential blocks, 1 brass hydrant, 2 platform scales, 1 hay scales, 2 step ladders, 5 ladders, 2 lanterns, 2 lawn mowers, 1 barometer, 2 thermometers, 2 iron wheelbarrows, 2 iron pails, 2 indicators, 3 steam gauges, 23 cakes of soap, 1 broom, 2 floor brushes, 1 gas lamp with tubing, 1 24-inch elbow, 6 grate sections with bars, 1 10-inch valve, 2 clocks, 1 bookcase, 1 bed, 3 chairs, 1 table, 1 desk, 1 mop, 1 dustpan, 4 Stillson wrenches, 5 cuspidores, 1 extra check valve for high duty Worthington, 1 set drawings for high duty Worthington, 1 ratchet, 1 flue scraper, 1 oil cupboard, 10 5-inch rubber valves, 10 pounds Italian flax, 50 feet felting, 25 gallons machine oil, 25 gallons cylinder oil, 10 pounds cotton waste, 4

pounds asbestos packing, 30 pounds Knowlton packing, 90 springs for high duty Worthington, 45 brass plates for high duty Worthington, 3 pounds Daniels packing, 12 pounds Garlock packing.

#### PROPERTY AND TOOLS AT PUMPING STATION, No. 2.

One work bench, 1 vise, 1 bitstock, 1 clock, 1 thermometer, 7 cold chisels, 4 monkey wrenches, 10 socket wrenches, 14 wrenches, 2 pinch bars, 2 gate wrenches, 3 steel drills, 1 sledge hammer, 1 coal hammer, 2 long steel chisels, 4 taps, 1 axe, vice chisels, 2 long handle shovels, 1 grapple rake, 1 hand hole gasket, 1 slice bar, 1 boiler hoe, 2 iron wheelbarrows, 1 platform scales, 4 lamps, 1 30-foot Howe platform scales, 200 feet cotton hose, 2 brooms, 1 map of Lowell, 3 Stillson wrenches, 1 gallon measure, 15 pounds waste,  $\frac{1}{2}$  barrel spindle oil, 1 tunnel, 12 pounds hemp packing, 3 oil cans, 1 glass pitcher, 4 glasses, 15 spindles for Dean pump, 35 valve plates, 35 springs, 1 desk, 2 chairs, 1 grindstone, 6 sheets emery paper, 2 files, 1 copper hammer, 2 ladders, 1 step ladder, 1 map, 1 iron pail, 25 feet 1-inch rubber hose, 2 picks, 2 shovels, 1 12-inch die-plate and dies, 1 6-inch pipe cutter, 1 5-gallon oil can, 20 pounds soda ash, 9 gauge glasses, 1 ratchet drill, 2  $\frac{1}{4}$ -inch taps, 6  $1\frac{1}{2}$ -inch iron nuts, 1 brush, 1 well wrench, 1 hydrant wrench, 1500 bricks, 2 fire shovels, 3 60-gallon oil tanks, 1 ring for water piston, 1  $\frac{3}{4}$ -inch tap, 6 pounds ring packing, 1 sprinkling can, 1 square pointed shovel, 1 long handle scoop, 2 long handle shovels, 1 scythe, 2 hoes, 1 iron tube cleaner, 2 mops, 1 2-inch brass valve, 4 2-inch iron couplings, 1 lantern, 25 feet rubber hose for blowing out tubes, 1 2-inch Worthington meter, 1 pair rubber boots, 19 3-inch couplings, 600 pounds old grates, 6 2-inch tees flange branches.

#### PROPERTY AND TOOLS AT PUMPING STATION No. 3.

Five wrenches for Worthington pump, 1 18-inch monkey wrench, 1 12-inch monkey wrench, 1 8-inch monkey wrench, 2 Stillson wrenches, 4 guard wrenches, 3 offset wrenches, 8 socket wrenches, 2  $\frac{3}{4}$ -inch bolts, 3  $\frac{1}{2}$ -inch bolts,  $\frac{1}{2}$  box  $\frac{5}{8}$ -inch square flax packing, 1 tunnel, 1 dust pan, 1 brush, 1 broom, 1 2-inch well scraper, 1 brass tray, 6 6 inch rubber valves, 24 4-inch springs, 1 8-foot ladder, 1



step ladder, 1 stand, 1 9-foot running board, 9 feet 1  $\frac{1}{4}$ -inch rubber hose, 8 feet  $\frac{3}{8}$ -inch rubber hose, 1 bench, 1 platform scales, 1 iron wheelbarrow, 2 coal shovels, 1 sledge hammer, 1 broom, 1 slice bar, 2 boiler hoes, 1 hook bar, 1 pail, 6 drip pans, 6 brass oil cans and tray, 1 2-quart can, 2 gate wrenches, 3 chairs, 2 dippers, 1 lantern, 3 B. & H. lamps, 2 large lamps, 1 bracket lamp, 1 shade lamp, 2 60-gallon oil tanks, 1 waste can, 6 pounds waste, 1 5-gallon can, 1 iron rake, 1 mop, 1 hoe, 1 24-inch flange, 2 shovels, 1 pick, 1 2-inch scraper, 1 faucet, 1 desk, 18 feet 8-inch pipe, 3 hand hole gaskets, 1 1-inch die stock and die, 1 2-inch die stock and die, 1  $\frac{3}{4}$ -inch die, 1 pipe vise, 1 hydrant wrench, 8 5-inch rubber valves, 22  $4\frac{1}{2}$ -inch rubber valves, 9 springs for valves, 1 coal hammer, 1 hatchet, 25 feet  $1\frac{1}{2}$ -inch rubber hose for blowing out tubes, 1 post hydrant wrench, 50 pounds of cement, 1 spirit level.

#### PROPERTY AND TOOLS AT PUMPING STATION, No. 4.

Two desks, 1 ink stand, 2 chairs, 3 small lamps, 4 large lamps, 5 lanterns, 3 brooms, 1 whisk broom, 1 mirror, 1 gate plan, 3 thermometers, 1 brush, 9 gauge glasses, 3 large lamp wicks, 18 small lamp wicks, 20 sheets emery cloth, 4 2-inch valve discs, 2  $1\frac{1}{2}$ -inch valve discs, 8  $1\frac{1}{4}$ -inch valve discs, 3 1-inch valve discs, 3  $\frac{1}{2}$ -inch valve discs, 2-gallon boiler enamel, 50 gallons kerosene, 4 gallons engine oil, 15 gallons cylinder oil, 2 60-gallon oil tanks, 1 cold chisel, 9 socket wrenches, 4 S wrenches, 2 spanner wrenches, 1 24-inch Stillson wrench, 1 24-inch monkey wrench, 11 2-inch Stillson wrench 2 12-inch monkey wrenches, 1 pair  $2\frac{1}{2}$ -inch adjustable pipe tongs, 17 pump wrenches, 10 packing hooks, 11 eye bolts, 1 screw driver, 1 oil set with stand. 2 hammers, 2 oil cans, 1 saw, 1 hatchet, 1 dust pan, 2 mops, 1 lever for feed pump, 25 pounds of waste, 1 floor brush, 15 large lamp chimneys, 13 small lamp chimneys, 20 pounds square tucks packing, 2 pounds Knowlton ring packing, 3 feet  $\frac{1}{4}$ -inch square Garlock packing, 15 feet  $\frac{3}{8}$ -inch square Garlock packing, 10 feet  $\frac{1}{2}$ -inch square Garlock packing, 2 pounds Jenkins sheet packing, 3 pounds rainbow packing, 2 pounds sheet rubber sheet packing, 1 ball lamp wicking, 1 hand lamp, 2 pounds hemp packing, 2 pounds tallow, 1 level, 12 pump valves, 1 set pump springs, 9 fire irons, 1 gate wrench,  $\frac{1}{2}$  cask lime, 1 half-barrel mineral paint, 1 boat, 1 iron rake, 3 shovels, 2 picks, 3 coal shovels, 1 grind-

stone, 1 scythe and snath, 1 3-inch tube scraper, 1 blow-out hose, 50 feet  $\frac{3}{4}$ -inch rubber hose, 1 ground hoe, 1 bench, 1 vise, 1 anvil, 1 coal barrow, 1 wheelbarrow, 1 pump, 1 platform scales, 1 whitewash brush, 1 set grate bars, 20 feet of small chain, 50 feet  $\frac{1}{2}$ -inch pipe for cleaning wells, 2 dippers, 1 sledge hammer, 1 trowel, 1 20-foot ladder, 4 feet 6-inch soil pipe, 200 feet 2-inch plank, 1 2-inch flange coupling, 8 1-inch couplings, 1  $1\frac{1}{4}$ -inch coupling, 1  $2\frac{1}{2}$ -inch elbow, 5  $\frac{1}{2}$ -inch couplings, 2  $1\frac{1}{4}$ -inch elbows, 1 1-inch elbow, 3  $\frac{3}{4}$ -inch elbows, 2  $\frac{3}{8}$ -inch elbows, 10  $\frac{1}{2}$ -inch elbows, 1  $1\frac{1}{2}$ -inch tee, 5 1-inch tees, 6  $\frac{1}{2}$ -inch tees, 1  $\frac{3}{8}$ -inch tee, 1  $\frac{1}{4}$ -inch tee, 3 pipe hangers, 1  $\frac{3}{4}$ -inch service cock, 7 feet  $1\frac{1}{4}$ -inch brass pipe, 21 feet 2-inch iron pipe, 20 feet  $1\frac{1}{2}$ -inch iron pipe, 14 feet  $1\frac{1}{4}$ -inch iron pipe, 15 feet 1-inch iron pipe, 21 feet  $\frac{3}{4}$ -inch iron pipe, 75 feet  $\frac{1}{2}$ -inch iron pipe, 31 feet  $\frac{3}{8}$ -inch iron pipe, 12 feet  $\frac{1}{4}$ -inch iron pipe.

#### PROPERTY AT STABLE.

Seven horses, eight single harnesses, 1 set double harness, 8 street blankets, 1 single truck, 1 double truck, 7 sleighs, 1 Goddard buggy, 5 wagons, 2 democrat wagons, 7 stable blankets, 4 brooms, 6 brushes, 6 curry combs, 6 pitchforks, 50 feet 1-inch rubber hose, 1 string of bells, 1 chamois,  $\frac{1}{4}$ -box harness blacking, 5 sponges, 1 wagon jack, 1 hay cutter, 2 feed boxes, 1 sprinkling can, 6 whips, 11 tons of hay, 375 bushels oats, 700 pounds straw,  $\frac{1}{4}$ -barrel Standard Food, 25 pounds shorts, 3 lap robes, 1 wolf skin robe, 2 pails, 3 pounds axle grease, 1 can harness oil, 1 large sunshade, 2 wagon covers, 1 scythe, 1 round pointed shovel, 1 bench, 1 cupboard, 400 pounds rock salt, 7 fly nets, 5 harness hooks, 7 halters, 1 snow shovel, 1 scoop shovel, 4 bail hooks, 3 hitch ropes, 2 wagon tops, 1 carriage top.

#### PROPERTY AND TOOLS AT BLACKSMITH SHOP.

One forge and bellows, 3 anvils, 1 sledge hammer, 1 striking hammer, 3 blacksmith hammers, 1 caulking hammer, 1 steel square, 11 cutters, 5 handle punchers, 6 hand punchers, 32 blacksmith's tools, 1 gate wrench, 14 pair tongs, 1 pair calipers, 1 work bench, 1 vise, 1 draw knife, 2 Lowell Water Works stamps, 1 portable forge,

1000 pounds old iron, 30 pounds pick steel, 20 pounds machine steel, 25 pounds Norway iron, 1 closet, 1 pair pliers, 49 picks, 1 grub pick, 3 stone chains, 8 crow bars, 1 coal hod, 92 old iron nuts, 1 coal shovel, 50 pounds blacksmith's coal, 131 feet  $1\frac{1}{8}$ -inch drills, 89 feet  $1\frac{1}{4}$  inch drills, 25 feet tag rope chain, 9 spoons, 9 pick handles, 1 stone mason hammer, 1 spanner, 1 file, 1 blacksmith sow, 1 broom, 1 steel tunnelling bar, 20 pounds wrought iron, 21 feet 1-inch drill steel, 1 tee sidewalk wrench, 1 water pail.

PROPERTY AT RESERVOIR—[LOW SERVICE].

One boat, two lawn mowers, 1 scythe, 1 wooden rake, 1 vine rake, 1 snath, 1 long handle shovel, 1 crow bar, 1 monkey wrench, 1 long handle hoe, 1 wooden shovel, 1 axe, 1 ice chisel, 1 lantern, 1 wheelbarrow, 1 broom, 1 pail.

PROPERTY AND TOOLS AT INLET HOUSE.

One hoe, 1 ice dipper, 1 gate wrench, 1 ice chisel, 1 ice hook, 1 square pointed shovel.

PROPERTY AND TOOLS AT GALLERY HOUSE.

Sixteen screens, 1 boat, 3 oars, 2 sets iron blocks and falls, 2 tag ropes, 1 gate wrench, 1 fork wrench, 1 tee wrench, 1 snow shovel, 1 round pointed shovel, 1 broom, 1 ice rake, 2 ice Hooks, 25 feet 1-inch rubber hose.

PROPERTY AND TOOLS AT BODWELL GATE HOUSE.

One round pointed shovel, 1 gate wrench, 1 pick, 1 12-foot ladder.

MOVEABLE FIXTURES AND PROPERTY AT OFFICE, CITY HALL.

Two roll-top desks, 2 standing desks, 1 double flat desk, 1 3-place inspector's desk, 1 2-place inspector's desk, 2 single inspector's

desks, 2 heavy oak tables, 1 typewriter desk, 1 Remington typewriter, 1 small table, 1 vault table, 2 swivel upholstered chairs, 6 upholstered chairs, 12 cane seated arm chairs, 8 swivel cane seated chairs, 2 high chairs, 2 stools, 1 step chair, 1 settee, 1 bookcase, 1 water tank, 2 water-pressure gauges, 2 thermometers, 1 clock, 2 table gas lamps, 33 framed pictures—plans, etc.; 2 floor rugs, 1 rubber mat, 1 set street tools, 2 earthen spittoons, 6 brass spittoons, 6 waste paper baskets, 1 shovel (historic), 2 mirrors, 1 letter copying press, 2 umbrella racks, 20 inkstands, 2 pen racks, 1 gas stove, 4 book racks, set tools (hammer, wrench, 2 screwdrivers, wire cutter, 1 plane, 1 saw, 1 chisel), 3 tumblers, boot-blackening outfit, 1 hair brush, 1 clothes brush, 1 match chest, 1 fire insurance map of Lowell, 1 atlas city of Lowell, 5 tin yearly boxes, 1 set Massachusetts statutes, 1 large dictionary, 1 large photograph album, 1 revolving bookcase, 1 card index case.

#### PROPERTY AND TOOLS IN STOCK ROOM.

Nineteen hundred pounds of pig lead, 256 pounds old lead, 278 pounds yarn, 925 pounds wiping solder, 425 pounds soft solder, 173 pounds sheet rubber packing, 494 feet  $\frac{3}{4}$ -inch lead lined iron pipe, 625 feet 1-inch, 104 feet  $1\frac{1}{4}$ -inch, 1297 feet  $1\frac{1}{2}$ -inch, 211 feet 2-inch, 50 feet 2-inch iron pipe, 1 8-inch hydrant disc, 2 6-inch hydrant discs, 1 4-inch hydrant disc, 10 backs for fountains, 6 bottoms for fountains, 11 aprons for fountains, 148 assorted rubber gaskets, 17 assorted rubber washers, 7 barrels of cement, 27 pounds dualin, 40 exploders, 3 pounds grass seed, 2 batteries with wires, 2 rolls copper wire, 1 barrel of lantern globes, 57 pounds of clay, 61 assorted portions brass spindles for gates, 49 spindles for hydrants, 7 independent gates for Chapman hydrant, 2 brass nipples for hydrants, 25 hydrant caps, 4 lengths  $2\frac{1}{2}$ -inch rubber hose, 2 brass bushings for Worthington pumps, 2 brass heads for Worthington pumps, 2 4-inch iron valves, 8 iron plates for water gates, 66  $\frac{3}{4}$ -inch goose necks, 11 1-inch goose necks, 1 2-inch goose neck, 4 Chapman hydrant tops, 2 Boston Post hydrant tops, 2 barrels for Chapman hydrant, 19 hydrant spindles, 15 leather valves for hydrants, 17 flush hydrants, 2 2-inch Peet valves, 7 spirit levels, 14 gallons Solarine metal polish, 4 cans Solarine paste, 2 cans raw umber, 8 pounds putty, 85 pounds plumago, 19 pipe tongs, 3 pairs

chain tongs, 13 die stocks, 47 dies, 5 pipe cutters, 7 caulking hammers, 1 iron jack, 1 6-inch flange offset, 1 4-inch flange offset, 160 pounds cotton waste, 1 pipe rack, 3 Pitcher pumps, 1 oil tank with pump connected, 48 gallons cylinder oil, 1 tunnel, 3 pounds of mop waste, 10 pounds  $\frac{1}{2}$  inch copper wire, 1 bull's-eye lantern, 17 pounds leather, 17 assorted post hydrant wrenches, 9 flush hydrant wrenches, 11 lengths hose for marine pumps, 3 tapping machines; lead pipe—200 pounds 2-inch, 142 pounds  $1\frac{1}{2}$ -inch, 615 pounds 1-inch, 1250 pounds  $\frac{3}{4}$ -inch, 625 pounds  $\frac{5}{8}$ -inch, 250 pounds 4-inch, 25 feet chain for fountain dipper, 10 pounds prepared flax packing, 1 6-inch tapping machine complete, 5 tapping drills, 1 ratchet and chain, 1 marlin spike, 1 full set of hydrant tools, 1 set bridge irons for staging, 20 pounds felt, 2 sets 24-inch heads and rods for floating pipe, 83 pounds sheet lead, 15 tons old iron, 1 4-foot pulley for motor, 35 feet 1-inch copper wire; meters—4 2-inch Worthingtons, 5  $1\frac{1}{2}$ -inch Worthingtons, 1 1-inch Worthington, 9  $\frac{5}{8}$ -inch Worthington, 4 1-inch Crowns, 3  $\frac{3}{4}$ -inch Crowns, 2  $\frac{5}{8}$ -inch Crowns, 2  $\frac{3}{4}$ -inch Empires, 1  $\frac{5}{8}$ -inch Empire, 1  $\frac{3}{4}$ -inch Nash, 6  $\frac{5}{8}$ -inch Nash, 3  $\frac{3}{4}$ -inch Lamberts, 2  $\frac{5}{8}$ -inch Lamberts, 10  $\frac{3}{4}$ -inch Tridents, 4  $\frac{5}{8}$ -inch Tridents, 9  $\frac{3}{4}$ -inch Unions, 6  $\frac{5}{8}$ -inch Unions, 6  $\frac{3}{4}$ -inch Herseys, 4  $\frac{5}{8}$ -inch Herseys, 6  $\frac{3}{4}$ -inch Niagaras, 5  $\frac{5}{8}$ -inch Niagaras, 4  $\frac{5}{8}$ -inch Columbias, 1 6-inch Gem, 2 bottoms for  $\frac{5}{8}$ -inch Trident meters, 12 clocks for  $1\frac{1}{2}$ -inch and 2-inch Worthington meters, 20 clocks for  $\frac{5}{8}$ -inch Worthingtons, 15 tops and ratchets for Worthington meters, 18 covers for  $\frac{5}{8}$ -inch Crown meters, 29 covers for  $\frac{3}{4}$ -inch Crown, 9 covers for 1-inch Crown, 4 1-inch cellar cocks, 13 1-inch sidewalk cocks, 7 1-inch Corporation cocks, 9  $\frac{3}{4}$ -inch cellar cocks, 97 sidewalk cocks, 68  $\frac{3}{4}$ -inch Corporation cocks; brass castings—109  $\frac{3}{4}$ -inch plugs for cellar cocks, 19  $\frac{3}{4}$ -inch plugs for sidewalk cocks, 152  $\frac{3}{4}$ -inch plugs for Corporation cocks, 7 1-inch plugs for Corporation cocks, 1 1-inch plug for cellar cock, 251 barrels for Corporation cocks, 622 washers for  $\frac{3}{4}$ -inch cocks; clips—1 30-inch, 1 24-inch, 1 16-inch, 2 12-inch, 2 10-inch, 5 8-inch, 4 6-inch, 12 clamps, 1 cross cut saw, 3 paving hammers, 1 blade for scythe, 139 brass tags, 19  $\frac{3}{4}$ -inch steam gauge glasses, 1 50 foot steel tape line, 31  $\frac{3}{8}$ -inch rubber washers, 4 4-inch lamp wicks, 1 whitewash brush, 45 lanterns, 5 21-pound sledge hammers, 2 round pointed shovels, 3 coal scoops, 16 pick handles, 4 brass padlocks, 4 locks and keys, 2 chisels, 1 boiler tube cleaner, 3 plumb bobs, 1 dipper, 7 small chimneys for lanterns, 7 brass screws for marine pumps, 90  $2\frac{1}{2}$ -inchx $\frac{1}{2}$ -inch bolts, 1  $1\frac{1}{2}$ -inch steam valve, 1 steam gauge, 1 electric

gong, 1 belt for electric moror, 229 lag screws, 50 hand hole gaskets, 4 man hole gaskets, 70 1-inch plugs, 10  $\frac{3}{4}$ -inch plugs, 1 box toilet paper, 7 pounds assorted bolts, 10 brooms, 2 crow bars, 1 pinch bar, 1 adze, 105 iron washers, 7 cast iron pipe cutters, 3 small brass pumps, 50 feet block tin tubing, 50 feet block tin rod, 17 diamond points, 4 yarning irons, 15 caulking sets, 7 cold chisels, 11 wedges, 3 bursting wedges,  $1\frac{1}{2}$ -pounds shims and wedges, 11 stone points, 2 bull points, 2 rubber seats, 22 pair rubber boots, 200 pounds tallow, 22 pounds braided hemp packing, 16 pounds Euraka packing, 6 pounds ring packing, 50 feet rubber hose, 56 pounds rainbow packing, 40 pounds rubber packing, 3 lights of glass, 10 hand drills, 1 jaw for 24-inch Stillson wrech, 7 Lowell Water Works stamps, 1 Norton door check and spring, 1 steel square, 1  $1\frac{1}{2}$ -inch augur, 6  $\frac{3}{4}$ -inch valves, 1 set bevel gears for gate, 3 gallons lard oil, 1 iron top for marine pump, 2 hand brushes, 1 floor brush, 4 diaphragms for marine pump, 4 pounds sponges, 317  $1\times\frac{3}{4}$ -inch couplings, 195  $\frac{3}{4}$ -inch smooth tail pieces, 720 nuts for  $\frac{3}{4}$ -inch cocks, 59 1-inch washers, 44  $\frac{3}{4}$ -inch elbows, 36  $\frac{3}{4}\times\frac{1}{2}$ -inch elbows, 260  $\frac{3}{4}\times\frac{1}{2}$ -inch couplings, 27 1-inch smooth tail pieces, 6 portions of valves for Worthington pump; iron fittings, lead lined—5  $1\frac{1}{2}$ -inch Unions, 5 2-inch Unions, 8 2-inch nipples, 12  $1\frac{1}{4}$ -inch nipples, 6 2x1-inch crosses, 2 1-inch crosses, 2  $\frac{3}{4}$ -inch crosses, 4  $1\frac{1}{2}\times\frac{3}{4}$ -inch crosses, 6 2x1 $\frac{1}{2}$ -inch crosses, 36 1-inch couplings, 18 2-inch couplings, 17  $1\frac{1}{2}$ -inch couplings, 2 2x1-inch reducing couplings, 11 2x1 $\frac{1}{2}$ -inch, 11  $1\frac{1}{2}\times 1$ -inch, 17  $1\times\frac{3}{4}$ -inch, 136  $\frac{3}{4}\times\frac{1}{2}$ -inch, 94  $\frac{3}{4}$ -inch elbows, 5  $1\frac{1}{4}$ -inch, 7 2-inches, 5  $1\frac{1}{2}\times\frac{1}{8}$ -inch turns, 4 2-inch  $\frac{1}{8}$  turns, 24  $1\times\frac{3}{4}$ -inch tees, 9  $1\frac{1}{2}$  inch, 2 2x $\frac{3}{4}$  inch, 11  $1\frac{1}{4}\times\frac{3}{4}$ -inch, 2  $1\frac{1}{2}\times\frac{3}{4}$ -inch, 17 2x $\frac{3}{4}$ -inch, 19  $\frac{3}{4}$ -inch tees.

IRON FITTINGS.—289  $\frac{3}{4}$  inch couplings, 242 1-inch, 15  $1\times\frac{1}{2}$ -inch, 33  $1\times\frac{3}{4}$ -inch, 81  $\frac{3}{4}\times\frac{1}{2}$ -inch, 5  $1\frac{1}{2}\times 1\frac{1}{4}$ -inch, 40 2-inch, 57  $1\frac{1}{2}$ -inch, 164 1-inch, 110  $\frac{3}{4}$ -inch, 32  $1\frac{1}{4}$  inch, 72  $1\times\frac{1}{2}$ -inch reducing couplings, 5  $1\frac{1}{4}\times\frac{1}{2}$ -inch, 8  $1\frac{1}{4}\times 1$ -inch, 82  $1\times\frac{3}{4}$ -inch, 97  $\frac{3}{4}\times\frac{1}{2}$ -inch, 9  $\frac{3}{4}$ -inch crosses, 7 1-inch, 10  $1\frac{1}{2}\times 1$ -inch, 2 2x1-inch, 66 1-inch nipples, 32  $\frac{3}{4}$ -inch, 13  $1\frac{1}{4}$ -inch, 3 2-inch, 12  $1\frac{1}{2}$ -inch, 6 1-inch caps, 7  $1\frac{1}{2}$  inch, 1 2-inch plug, 58 1-inch, 11  $1\frac{1}{4}$ -inch, 7  $1\frac{1}{2}$ -inch, 116  $\frac{3}{4}$ -inch, 101 1-inch elbows, 8 2-inch, 10  $1\frac{1}{2}$ -inch, 84  $\frac{1}{4}$ -inch, 7  $1\frac{1}{4}\times 1$ -inch, 1 2x1-inch tee, 1 2x1 $\frac{1}{2}$ -inch, 4  $1\frac{1}{4}$ -inch, 4  $1\frac{1}{2}\times\frac{3}{4}$ -inch, 3  $1\frac{1}{2}$ -inch, 3  $1\frac{1}{4}\times 1$ -inch, 4 1-inch, 10 2-inch unions, 15  $1\frac{1}{2}$ -inch, 71 1-inch, 51  $\frac{3}{4}$ -inch, 45  $1\frac{1}{2}\times\frac{1}{2}$ -inch bushings, 1 2x1 $\frac{1}{2}$ -inch  $1\frac{1}{2}\times\frac{1}{2}$ -inch, 75  $1\times\frac{3}{4}$ -inch, 91  $\frac{3}{4}\times\frac{1}{2}$ -inch, 8 2x1-inch y, 12 1-inch meter unions, 159  $\frac{3}{4}$ -inch, 115  $\frac{1}{8}$ -inch, 34 1-inch solder nipples, 62  $1\times\frac{3}{4}$ -inch 27  $\frac{3}{4}$ -inch.

**FLANGE PIPE.**—10 lengths 10-inch, 6 lengths 6-inch, 10 lengths 4-inch, 16 feet 24-inch; flange specials—4 16x12-inch, three ways, 1 8x6-inch. three ways, 6 10x8-inch reducers, 9 12x10 inch reducers, 1 18x16-inch reducer, 1 6-inch cap, 1 10-inch cap, 1 8-inch sleeve, 40 4-inch sleeves, 4 6½-inch turns, 1 ½-inch turn, 2 10-inch ¼ turns, 1 10-inch ⅛ turn.

**CAST IRON PIPE IN PIECES.**—30-inch, 19 feet; 24-inch, 62 feet; 20-inch, 67 feet; 16-inch, 45 feet; 10-inch, 11 feet; 8-inch, 11 feet 6-inches; 6-inch, 28 feet; 4-inch, 17 feet; 1 30-inch man hole, 1 6x2-inch Smith sleeve, 1 30-inch clamp sleeve, 1 24-inch clamp sleeve, 129 feet wrought iron pipe, 40 feet 4-inch, 2 Ludlow hydrants, 1 Coffin hydrant, 115 iron sidewalk boxes, 3 iron gate boxes, 5 wooden hydrant boxes, 3 6-inch check valves, 2 10-inch indicator gates, 4 6-inch indicator gates.





# REPORT OF CITY ENGINEER.

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OFFICE OF CITY ENGINEER,

LOWELL, MASS., Jan. 1, 1899.

*To the Lowell Water Board:*

Gentlemen—I have the honor to submit the Twenty-sixth annual report for the year ending December 31, 1898:

## PUMPAGE.

Total Pumpage for 1898 . . .	2,452,212,843	Galls.
Total Pumpage for 1897 . . .	2,406,240,452	"
An increase in 1898 of . . .	45,972,391	"
Increase in consumption in 1898 .	47,632,251	"

The greatest quantity pumped in one day in 1898 was 10,884,874 gallons, on February 2nd.

The greatest quantity pumped in one week was 66,853,654 gallons, an average of 9,550,522 gallons per day, which was pumped during the week of January 30th to February 5th.

High service pumpage for the year is 40,084,506 gallons, a decrease of 4,998,210 gallons from the quantity pumped last year.

The cost of pumping from low service pressure into the high service reservoir was Eleven Dollars and Seventy-five Cents (\$11.75) per million gallons, which, added to the cost of low service pumpage, Thirteen Dollars and Ninty-nine Cents (\$13.99) per million gallons, makes the total cost of high service pumpage for the year 1898 Twenty-five Dollars and Seventy-four Cents (\$25.74) per million gallons.

The following table shows source of supply, quantity pumped and cost per million gallons at the several pumping stations during the year 1898.

**TABLE SHOWING SOURCE OF SUPPLY, QUANTITY PUMPED AND COST AT THE SEVERAL STATIONS DURING THE YEAR 1898.**

[illegible]

The following tables showing the performance of the engines at Station No. 1 on West Sixth Street, depth and quantity of water in reservoir, average temperature of air and water, and the average monthly and daily consumption of water, have been calculated and compiled from the records of the engineer and gatekeeper.

**TABLE SHOWING WORK DONE WITH WORTHINGTON DUPLEX ENGINE FOR EACH MONTH  
DURING THE YEAR 1898.**

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**TABLE SHOWING WORK DONE WITH WORTHINGTON HIGH DUTY ENGINE FOR EACH  
MONTH DURING THE YEAR 1898.**

MONTHS.	No. of days pump- ing.	Average No. of hours pumping per day	No. of hours pumping per month.	No. of strokes made per month.	Average No. of strokes made per minute.	Average head, in- cluding friction in feet.	Quantity pumped per month in U. S. gallons.	Average quantity pumped per day in U. S. gallons.	No of pu- mp- ing vol- ume con-	Duty in lbs. 1 ft. high with 100 lbs. coal used in pump- ing only; no deduction for ashes or clinkers.	Duty on total coal consumed; no deduction for ashes or clinkers.
January ....	27	10.22	271.00	141,147	8.68	163.94	52,880,125	1,960,375		28,866,880	71,060,885
February ..	22	11.55	252.00	152,201	9.68	163.98	57,075,375	2,594,835		88,683,000	76,106,140
March ....	30	13.27	269.00	143,003	8.42	163.83	53,983,625	2,598,181		98,738,028	83,347,000
April .....	26	20.20	532.30	243,134	7.81	163.86	91,176,750	3,506,798		101,834,336	96,844,378
May ... ..	6	13.20	110.00	61,378	9.30	163.78	28,016,750	3,839,125		87,552,714	59,880,397
June . . . .	21	23.57	485.00	208,890	7.01	163.88	78,453,000	3,640,714		91,088,833	86,756,090
July .....	16	28.10	373.00	168,904	7.50	164.19	63,678,500	3,979,781	715	97,903,727	97,013,727
August....	31	22.58	712.00	356,560	8.35	164.07	135,710,000	4,315,220	661	96,839,813	90,890,688
September.....	28	23.05	646.30	316,287	8.15	164.07	118,598,875	4,235,317	631	86,277,627	86,277,627
October.....	27	22.37	610.30	284,475	7.77	164.14	106,678,125	3,951,042	627	96,233,590	86,728,940
November .....	27	20.41	559.30	234,336	6.99	163.91	87,875,625	3,254,653	545	81,580,352	74,451,061
December.....	31	22.45	705.30	328,318	7.77	163.86	123,304,875	3,977,577	614	86,668,060	83,871,808
<b>Totals and Averages..</b>	<b>282</b>	<b>19.86</b>	<b>5585.30</b>	<b>2,683,571</b>	<b>7.94</b>	<b>163.86</b>	<b>988,461,625</b>	<b>3,605,146</b>	<b>416</b>	<b>88,626,163</b>	<b>84,248,731</b>

TABLE SHOWING AMOUNT OF COAL USED FOR WORTHINGTON  
DUPLEX ENGINE AT PUMPING STATION  
DURING THE YEAR 1898.

MONTHS.	COAL CONSUMED.			
	For starting fires, in lbs.	When pump- ing, in lbs.	For banking fires, in lbs.	Total per month, in lbs.
January .....	.....	.....	.....	.....
February.....	.....	9,552	.....	9,552
March .....	.....	74,931	600	75,531
April .....	.....	.....	.....	.....
May.....	.....	.....	.....	.....
June.....	.....	.....	.....	.....
July .....	.....	157,153	.....	157,153
August .....	.....	13,630	.....	13,630
September .....	.....	33,875	.....	33,875
October .....	.....	.....	.....	.....
November .....	600	30,890	800	32,290
December .....	.....	.....	.....	.....
Totals .....	600	320,031	1,400	322,031

TABLE SHOWING AMOUNT OF COAL USED FOR WORTHINGTON  
HIGH DUTY ENGINE AT PUMPING STATION  
DURING THE YEAR 1898.

MONTHS.	COAL CONSUMED.			
	For starting fires, in lbs.	When pump- ing, in lbs.	For banking fires, in lbs.	Total per month, in lbs.
January .....	.....	83,155	18,600	105,755
February.....	1,000	86,963	14,400	102,363
March .....	3,000	74,629	8,700	86,329
April .....	1,500	122,269	4,800	128,569
May .....	1,000	35,883	15,600	52,483
June.....	300	114,661	5,400	120,361
July .....	.....	88,998	.....	88,998
August .....	1,000	201,266	.....	202,266
September .....	.....	187,944	.....	187,944
October .....	1,000	169,226	... ..	170,226
November .....	6,000	147,234	8,000	161,234
December .....	1,800	196,652	2,400	200,852
Totals .....	16,600	1,508,880	77,900	1,608,380



TABLE SHOWING WORK DONE WITH WORTHINGTON HIGH SERVICE ENGINE FOR EACH MONTH DURING THE YEAR 1898.

MONTHS.	No. of days pump- ing.	Average No. of hours pumping per day.	No. of hours pumping per month.	No. of strokes made per month.	Average No. of strokes made per minute	Average head including friction in feet	Quantity pumped per month in U. S. gallons	Average quantity pumped per day in U. S. gallons	No. gals of water pumped into reser- voir per lb. total coal consumed	Coal in lbs. used when pumping
January .....	25	10-36	265-00	190,146	11-98	69-44	2,682,044	106,482	299	8,905
February .....	19	12-32	229-00	161,820	11-78	69-44	2,265,480	119,236	301	7,515
March.....	22	16-27	353-00	207,991	9-82	69-44	2,911,874	132,358	300	9,695
April .....	22	18-50	414-30	188,405	7-58	69-44	2,637,670	119,894	300	8,796
May.....	14	10-00	140-00	144,263	17-17	69-44	2,019,682	144,263	300	6,727
June.....	23	22-23	515-00	255,837	8-28	87-57	3,581,718	155,727	300	11,986
July.....	31	24-00	744-00	358,765	8-04	92-59	5,022,710	162,023	300	16,736
August.....	31	24-00	744-00	347,825	7-79	92-59	4,869,550	157,082	300	16,214
September.....	30	24-00	720-00	331,805	7-68	92-59	4,645,270	154,842	299	15,546
October.....	27	22-42	613-00	316,539	8-61	87-45	4,431,546	164,131	300	14,769
November .....	14	16-26	230-00	163,615	11-86	69-44	2,280,610	163,615	305	7,511
December .....	15	19-56	299-00	196,168	10-98	69-44	2,746,352	183,090	300	9,153
Totals and Averages ...	273	19-17	5266-30	2,863,179	9-06	80-56	40,084,506	146,830	300	133,498

**PUMPING STATION, WORTHINGTON DUPLEX ENGINE.  
RUNNING EXPENSES FOR THE YEAR 1898.**

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Pay of engineers and firemen.....	\$585 86
43 1208-2000 tons of coal (Cumberland, 1897), at \$3.455 .....	150 65
117 823-2000 tons of coal (Cumberland, 1898), at \$3.393 .....	398 38
Electric light .....	20 25
Gas for lighting works.....	16 52
46.70 gallons of cylinder oil, at 0.542— .....	25 30
4.42 gallons of machine oil, at 0.198+ .....	87
25.09 pounds of packing, at 0.877+ .....	22 02
20.9 pounds of cotton waste, at 0.06½ .....	1 31
11 pounds of tallow, at 0.04½.....	47
Repairs on engine.....	3 35
Repairs on boilers.....	8 42
Tools and stock .....	4 80
Sundries .....	3 84
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Total .....	\$1,222 04

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Cost of pumping water into reservoir per million gallons, \$9.28.

Cost of pumping water one foot high per million gallons, .05 73-100.

PUMPING STATION, WORTHINGTON HIGH DUTY ENGINE.  
RUNNING EXPENSES FOR THE YEAR 1898.

Pay of engineers and firemen.....	\$4,372 56
340 tons of coal (Cumberland, 1897), at \$3.455.....	1,174 70
461 1380-2000 tons of coal (Cumberland, 1898), at \$3.393 .....	1,566 51
Electric light.....	156 49
Gas for lighting works.....	127 67
360.82 gallons of cylinder oil, at 0 542—.....	195 48
34.17 gallons of machine oil, at 0.198+.....	6 77
193.86 pounds of packing, at 0.877+.....	170 09
161.5 pounds of cotton waste, at 0.06½.....	10 09
89 pounds of tallow, at 0.04½.....	3 78
Repairs on engine.....	26 17
Repairs on boilers .....	65 10
Tools and stock .....	37 09
Sundries .....	29 66
Total.....	\$7,942 16

Cost of pumping water into reservoir per million gallons, \$8.03+.  
Cost of pumping water one foot high per million gallons, .04 90-100.

## RESERVOIR, BEACON STREET, 1898.

MONTHS.	Depth in feet.	Quantity in U S. Gallons.	Temperature in degrees.	
			Of water.	Of air.
January .....	19.83	30,219,027	43.12	24.94
February .....	19.50	29,664,877	41.71	28.56
March .....	19.24	29,239,892	45.60	41.69
April .....	19.29	29,322,283	47.68	42.68
May .....	17.19	25,844,397	54.45	56.53
June .....	18.63	28,223,292	64.30	66.48
July .....	17.94	27,078,072	70.61	72.96
August .....	19.26	29,262,226	73.94	72.35
September .....	19.10	28,998,625	69.50	65.49
October .....	18.16	27,433,018	61.58	52.73
November .....	19.98	30,480,736	51.63	40.05
December .....	19.15	29,076,682	43.67	28.42

TABLE SHOWING THE AVERAGE MONTHLY AND DAILY CONSUMPTION OF WATER FOR THE YEAR 1898.

MONTHS.	Gallons per month.	Gallons per day.
January .....	240,864,291	7,769,816
February .....	202,854,269	7,244,795
March....	193,213,632	6,232,698
April.....	186,084,835	6,202,828
May .....	198,248,509	6,395,113
June .....	198,361,448	6,612,048
July .....	221,458,681	7,143,828
August .....	216,090,052	6,970,647
September.....	202,293,572	6,743,119
October .....	195,319,193	6,300,619
November .....	183,860,970	6,128,699
December .....	215,925,813	6,965,349
Totals and Averages .....	2,454,575,265	6,724,864

## SUMMARY OF STATISTICS.

## REPORT OF 1898.

In accordance with the recommendations of the New England  
Water Works Association.

## LOWELL WATER WORKS, MIDDLESEX COUNTY, MASS.

Population by census of 1895, 84,359.

Date of construction, 1870 to 1873.

Date of construction, High Service, 1881.

Date of construction, Driven Wells, 1893 to 1896.

Source of supply—two hundred twenty (220) driven wells in the  
valley of River Meadow Brook and one hundred sixty-nine  
(169) driven wells at Pawtucket Boulevard, and filter  
gallery to June 10th, 1898.

Mode of supply, pumping to reservoir and pumping direct.

## PUMPING.

## 1. Builders of pumping machinery :

## AT STATION NO. 1.

One engine, capacity 5,000,000 gals. in 24 hours, Henry  
G. Morris.

One engine, capacity 5,000,000 gals. in 24 hours, Henry  
R. Worthington.

One engine, capacity 10,000,000 gals. in 24 hours, Henry  
R. Worthington.

One engine, capacity 500,000 gals. in 24 hours, Henry  
R. Worthington.

## AT STATION NO. 2, TEMPORARY PUMPS.

One engine, capacity 3,000,000 gals. in 24 hours, The Deane Steam Pump Co.

One engine, capacity 3,000,000 gals. in 24 hours, The Deane Steam Pump Co.

## AT STATION NO. 3, TEMPORARY PUMPS.

One engine, capacity 3,000,000 gals. in 24 hours, Henry R Worthington.

One engine, capacity 3,000,000 gals. in 24 hours, Henry R. Worthington.

## AT STATION NO. 4, TEMPORARY PUMPS.

One engine, capacity 3,000,000 gals. in 24 hours, Knowles Steam Pump Works.

One engine, capacity 3,000,000 gals. in 24 hours, Knowles Steam Pump Works.

## 2. Description of coal used:

(b) Kind, bituminous.

(c) Size, broken.

(d) Brand, Cumberland.

(e) Price per gross ton delivered, \$3.418.

## 3. Coal consumed for the year, in pounds, 9,057,728 (1,925,411, Station No 1).

## 4. Wood consumed for the year, in pounds,

---

=coal in lbs=2,400, Station No. 1.

3

## 5. Total fuel consumed for the year, in pounds, 1,927,811, Station No. 1.

## 6. Total pumpage for the year, in gallons, 2,452,212,843 (1,120,131,565, Station No. 1).

7. Average static head against which pumps work, 156.33, Station No. 1.
8. Average dynamic head against which pumps work, 163.77, Station No. 1.
9. Number of gallons pumped per pound of coal, 275. (581 Station No. 1.)
10. Duty in foot pounds per 100 pounds of coal, using the following formula, making no deduction for starting or banking fires, or heating building:

$$\text{Duty} = \frac{\text{Gallons pumped (6)} \times 8.34 \text{ (lbs.)} \times 100 \times \text{dynamic head (8)}}{\text{Total fuel consumed (5)}} = 79,380,607, \text{ Station No. 1.}$$

COST OF PUMPING FIGURED ON PUMPING STATION EXPENSES OF \$9,164.19, STATION NO. 1.

11. Per million gallons raised against average dynamic head (8) into reservoir, \$8.18.
12. Per million gallons raised one foot high (dynamic), \$0.05.

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Analyses of the water from the several driven well plants have been made each month by the State Board of Health, a record of which is annexed.

An examination of this record will show that the driven well water still maintains the high standard of purity shown by former analyses.

Respectfully submitted,

GEORGE BOWERS,

City Engineer.



COMMONWEALTH OF MASSACHUSETTS.—STATE BOARD OF HEALTH, LOWELL.  
WATER ANALYSIS,—Merrimack River.  
(PARTS IN 100,000).

1885

4

1886

1887

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**COMMONWEALTH OF MASSACHUSETTS.—STATE BOARD OF HEALTH, LOWELL.  
WATER ANALYSIS,—Cook Wells.**

(PARTS IN 100,000).

**NO. 1**

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COMMONWEALTH OF MASSACHUSETTS.—STATE BOARD OF HEALTH, LOWELL.

WATER ANALYSIS,—Hydraulic Wells.

(PARTS IN 100,000).

No.	DATE OF		APPEARANCE.			ODOR.		RESIDUE ON EVAPORATION.			AMMONIA.			Chlorine.	NITROGEN AS		Hardness.	Iron.	Oxygen Consumed
	Collec- tion.	Exami- nation.	Turbid- ity.	Sediment.	Color.	Cold.	Hot.	Total	Loss in evap.	Fixed.	Free.	Albuminoid.			Nitrates.	Nitrates.			
												Total	In so- lution	In sus- pension					
21,888	Jan., 1898 18 19		Decided	Cons.	0.30	Faintly earthy.	None.	10.30	....	....	.0088	.0058	....	....	.0030	.0001	4.7	.0380	.2000
22,229	Feb. 15 16		Decided	Cons. foculent.	t'ribid 0.20	None.	None.	9.70	....	....	.0088	.0072	...	....	.0050	....	3.8	.0300	.2080
23,179	May 17 17		Slight.	Slight.	0.38	None.	None.	8.10	..	....	.0088	.0068	....	....	.0080	....	3.5	.0470	.2300
23,552	June 14 15		Slight milky.	Slight iron.	0.29	None.	None.	8.30	....	....	.0092	.0074	....	....	.0040	....	3.4	.0350	.2720
23,991	July 20 22		Decided	Cons.	fl. 0.26	None.	None.	8.70	....	....	.0076	.0086	....	....	.0060	.0001	2.9	.0500	.2720
24,698	Sept. 20 21		Decided milky.	Cons.	0.28	None.	None.	8.00	....	....	.0088	.0084	....	....	.0070	.0001	3.1	.0570	.2720
25,076	Oct. 18 19		Slight milky.	Very slight.	0.28	None.	None.	8.40	....	....	.0092	.0086	....	....	.0060	.0001	3.6	.0480	.3040

COMMONWEALTH OF MASSACHUSETTS.—STATE BOARD OF HEALTH, LOWELL.  
WATER ANALYSIS,—Boulevard Wells.  
(PARTS IN 100,000).

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1. The first step in the process is to identify the problem or issue that needs to be addressed. This involves gathering information and understanding the context of the problem.



TWENTY-SEVENTH  
ANNUAL REPORT  
OF THE  
**Lowell Water Board**  
TO THE  
CITY COUNCIL OF THE CITY OF LOWELL, MASS.,  
AND THE  
REPORTS OF THE SUPERINTENDENT OF WATER WORKS AND OF THE  
CITY ENGINEER TO THE WATER BOARD FOR 1899.

LOWELL, MASS.:  
UNION PRINTING COMPANY.  
1900.

171

P1428:1

## CITY OF LOWELL.

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IN BOARD OF ALDERMEN, Feb. 27, 1900.

Received and ordered on file ; sent down for concurrence.

GIRARD P. DADMAN, *City Clerk*.

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IN COMMON COUNCIL, March 6, 1900.

Received and ordered on file, in concurrence.

FRANK M. DOWLING, *Clerk*.

# WATER DEPARTMENT, 1900.

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## WATER BOARD.

**FRANK L. WEAVER**, President.

Term expires second Monday in March, 1900.

**MICHAEL J. DOWD**,

Term expires second Monday in March, 1901.

**AUGUST FELS**,

Term expires second Monday in March, 1902.

**HERBERT C. TAFT**,

Term expires second Monday in March, 1903.

**J. W. CRAWFORD**, Secretary and Clerk.

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**ROBERT J. THOMAS**, Superintendent.

**GEORGE BOWERS**, City Engineer.

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**D. B. H. BARTLETT**, Engineer.

**WILLIAM JOYCE**, Asst. Foreman.

**THOMAS McLOUGHLIN**, Engineer.

**JOHN E. LOWNY**, Meters.

**JOHN B. HENRY**, Reservoir.

**ARTEMAS S. YOUNG**, Foreman Shop.

**THOMAS F. DOYLE**, Foreman.

**A. F. COGER**, Hydrants and Gates.

**THOMAS ROGERS**, Services.

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## OFFICE.

**GEO. E. WORTHEN**, Service Clerk.

**GERTRUDE W. BYAM**, Bookkeeper.

**JULIA J. RAFTER**, Asst. Bookkeeper.

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## INSPECTORS.

**ROBERT GARDNER, JR.**

**MICHAEL H. MCCUE.**

**FREDERICK A. BARON.**

**GEORGE F. TILTON.**

**WALTER P. WILEY.**



# REPORT OF THE WATER BOARD.

OFFICE OF THE WATER BOARD,

CITY HALL,

LOWELL, MASS., Jan. 1st., 1900.

*To His Honor the Mayor and City Council of the  
City of Lowell:*

Complying with the requirements of the city ordinances, herewith is presented the twenty-seventh annual report of the Water Board for the year ending December 31st, 1899. There was but one change in the membership of the board, Mr. H. C. Taft succeeding Mr. S. H. Jones, whose term expired in March.

It has been our endeavor to maintain the efficiency of the Water Works at the high standard it has always attained, but being deprived of the income from pay for care of fire hydrants and street fountains, we have been unable to make any

extensive additions to the present system; the amount of pipe laid is the smallest since the works started. The most important new work has been the construction of a shed at the yard for the storage and protection of the large amount of fittings it is necessary to always have on hand and available for use.

In June a communication was received from the State Board of Health advising us that, "the State Board has recently made investigations in the City of Lowell with reference to the action of the public water supplies of the city upon the service pipes through which the water is supplied the consumers, a large portion of which it appears, is of lead." The State Board further states that, "the Cook and Hydraulic wells contain more carbonic acid, and the Boulevard wells contain less, than other places in the State where lead poison prevails, and advises that two courses appear to be at hand; one is to remove all lead service pipes through which water from the Cook and Hydraulic wells is drawn for cooking or drinking, and the other is to cease using the Cook and Hydraulic well water and extend the Boulevard well system to supply the whole city," under these conditions this department will necessarily be put to unusual expense either in changing pipes or procuring additional water.



Upon receipt of this communication the President and Superintendent were appointed a committee to obtain information toward employing a chemist to make complete and exhaustive tests of the water, to obtain all the information possible as to the nature and conditions under which this action takes place, and Professor Charles Harrington of the Harvard Medical School was employed, and over one hundred samples of water were sent him, but he has not yet rendered his report.

November 24th, the Board made a request of the Massachusetts State Board of Health for their assistance in investigating certain sources of water supply, such as Beaver Brook above Collinsville, Forge Pond, and other places to determine the quality and quantity that could be obtained. It being apparent from their subsequent report that these sources were not available for water supply, the Superintendent was then instructed to drive a number of experimental wells on Beaver Brook, and to drive additional wells at the Boulevard, to obtain more water from that source.

The decision of the court in the suit of E. S. Howe, et. al., against the City, to reclaim land on the Boulevard for violation of the terms of agreement on account of establishing a pumping plant thereon, was adverse to the City; the judgment of the court being that the land on which

Pumping Station No. 4 is situated and all the improvements thereon reverts back to Mr. Howe. Through the efforts of the City Solicitor, Mr. Howe agreed to accept \$2,250 for the 3 94-100 acres and release all claims, which amount has been paid by the Water Works Department.

During the summer the three houses encroaching on the Conduit line, mentioned in the last report, have been removed, as has also the barn of E. T. Genest, so that now the whole line of Conduit and Tunnel is free from encumbrance of buildings of any kind.

The finances of the department show a gratifying balance, the charges for water show a net increase of \$1,669.83, and while the charges by "rates" decreased \$6,048.33, the charges for metered water increased \$7,718.16 and the total charge for metered water is \$48,115.82 in excess of rated property. The record shows that almost exactly one-half of the services in use are metered, and while 2,659,464,909 gallons of water were used, 687,905,250 gallons were consumed through meters, that is, one-half of the services used one-quarter of the water and produced over 60 per cent. on the income.

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Total charges for water .....	\$209,004.56
Other charges.....	18,908.44
Uncollected from 1898.....	44,382.22
	<hr/>
	\$272,295.22

Collections.....	\$202,423.02
Discount .....	20,685.73
Abated .....	17,429.05
Uncollected to 1900.....	31,757.42
	<hr/>
	\$272,295.22

The report of the Superintendent shows in detail the work of the department, and the tables of the Engineer show the duty and cost of pumping.

FRANK L. WEAVER, President.  
AUGUST FELS,  
MICHAEL J. DOWD,  
HERBERT C. TAFT.

LOWELL WATER WORKS OFFICE,

January 1, 1900.

TO THE LOWELL WATER BOARD:

Gentlemen,—Herewith I submit figures detailing the finances of the Lowell Water Works for the year ending December 31st, 1899.

J. W. CRAWFORD,

Clerk.

TABLE I. FINANCIAL STATEMENT—LOWELL WATER WORKS, 1899.

	CHARGES				RECEIPTS				
	Water		Other than Water	Total Charges 1899	Total Charges 1900	Receipts	By Accounts		
	Rate	Metered					Total	Discounts	Abat'ments
Transfer .....				\$ 44,342 22	\$ 29,089 41	\$26,578 87	\$ 2,617 75	\$13,619 76	\$ 1,865 84
January .....	\$ 30 42	\$ 156 00	\$3,985 90	4,172 40	1,371 90	4,148 97	18 90	4 53	.....
February.....		252 78	516 12	768 90	1,082 17	505 22	3 92	.....	269 76
March .....	74,705 31	28,004 64	102,799 95	102,799 95	118,589 23	89,319 80	10,175 45	3,163 12	141 58
April .....			1,712 54	1,712 54	3,430 05	1,546 93	.....	6 50	159 11
May.....	2,676 62		1,811 08	4,487 70	2,579 16	3,872 06	257 43	164 40	193 72
June.....	1,679 80	41,050 33	2,870 10	45,970 23	41,537 90	40,356 56	4,240 08	252 15	740 84
July.....	431 71	33 46	1,861 52	2,326 00	1,942 73	1,775 37	42 90	41 59	466 83
August.....	6 02	540 71	1,917 90	2,464 72	1,608 55	2,121 07	52 88	30 46	251 31
September .....	285 65	31,614 52	1,369 77	33,269 94	32,527 59	29,756 06	3,177 41	31 29	305 18
October.....	287 57	64 08	1,453 47	1,805 12	1,244 60	1,262 45	23 13	75 67	443 87
November.....	108 70		646 88	775 58	1,252 08	311 89	4 23	5 42	454 04
December.....	232 57	26,753 67	742 99	27,729 23	27,568 46	867 77	71 05	15 07	26,775 34
Totals .....	\$80,444 37	\$128,560 19	\$18,908 44	\$272,236 22	\$263,823 98	\$202,423 02	\$20,686 73	\$17,429 05	\$31,757 42

TALBE II. FINANCIAL STATEMENT—LOWELL WATER WORKS, 1899.

OUTGO.

	Pay Roll and Salaries	Water Works Supplies	Interest and Principal	Refunds and Va- cancies	General Expense Account	Stable Depart- ment	Land	COAL				Totals	
								P. S. 1	P. S. 2	P. S. 3	P. S. 4	1899	1900
January.....	\$3,846 48	\$1,500 92	.....	\$ 52 44	\$211 67	\$ 28 81	.....	.....	.....	.....	.....	\$ 5,700 32	\$11,631 81
February.....	4,065 04	968 82	\$7,725 00	55 65	79 06	15 28	.....	.....	.....	.....	.....	12,908 85	12,879 62
March.....	3,808 65	714 81	300 00	.....	252 84	58 32	.....	.....	\$ 490 52	\$190 39	.....	5,955 53	12,356 39
April.....	5,372 05	2,077 90	720 00	72 25	231 03	101 11	.....	\$ 5310 02	942 38	166 12	\$522 39	10,715 34	9,780 58
May.....	5,126 53	15,246 80	20,198 00	1,325 13	234 97	314 64	.....	1,073 66	1,133 49	.....	579 93	45,233 15	30,536 26
June.....	5,380 90	4,151 27	1,140 00	147 38	82 99	198 53	.....	.....	1,192 93	731 49	.....	13,025 49	11,686 29
July.....	6,600 76	3,075 22	10,000 00	66 03	194 42	159 38	.....	1,207 64	77 30	413 82	608 02	22,462 59	22,096 09
August.....	5,067 15	2,002 82	3,225 00	217 95	394 08	148 00	\$2 250 00	.....	.....	.....	.....	13,305 00	12,127 42
September.....	5,818 21	2,059 73	240 00	51 31	371 06	20 29	.....	1,633 62	1,957 81	.....	780 88	13,164 91	7,610 07
October.....	4,743 35	2,826 19	220 00	162 38	154 80	16 57	.....	.....	.....	.....	.....	8,123 29	16,286 50
November.....	4,597 01	915 04	28,338 00	107 55	145 11	95 96	.....	.....	232 00	.....	750 83	34,949 52	30,348 56
December.....	5,457 17	1,234 89	8,640 00	86 61	218 20	71 42	.....	321 14	.....	.....	439 27	16,468 79	20,129 41
Totals.....	\$59,903 30	\$36,834 50	\$90,806 00	\$2,344 68	\$2,570 32	\$1,228 33	\$2,250 00	\$4,746 08	\$6,026 43	\$1,501 82	\$3,741 32	\$202,012 78	\$197,469 00



TABLE III. FINANCIAL STATEMENT—LOWELL WATER WORKS, 1899.

SUBDIVISION OF "OTHER THAN WATER CHARGES" FROM TABLE 1.

	Meters Sold	Expense Setting Meters	Meter Repairs	New Services	Changed Services	Labor and Material	Building Charges	Shut-off Fees	Sewer Flushing	Interest	Totals	
											1899	1908
January.....	\$ 49 50	\$ 6 25	\$ 14 85	\$ 10 07	.....	\$3,888 91	\$ 2 40	\$ 2 00	\$12 00	.....	\$3,985 98	\$1,150 85
February.....	188 50	60 20	146 48	.....	\$ 27 50	52 27	39 17	.....	8 00	.....	516 12	1,070 35
March.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
April.....	1,008 00	141 65	105 10	9 58	.....	384 21	.....	4 00	.....	.....	1,712 54	1,848 33
May.....	795 40	117 94	99 83	254 67	103 65	353 31	66 28	4 00	16 00	.....	1,811 08	1,341 94
June.....	1,120 00	161 85	126 84	176 44	318 13	878 77	15 30	2 00	16 00	\$ 54 77	2,870 10	1,701 08
July.....	620 80	95 36	51 05	175 48	118 40	725 92	18 48	44 00	12 00	272 83	1,861 52	1,835 57
August.....	392 25	52 99	33 68	236 20	114 92	779 46	27 66	8 00	.....	.....	1 917 99	982 27
September.....	521 70	54 86	32 00	127 40	61 70	555 31	10 80	6 00	.....	.....	1,369 77	1,007 20
October.....	841 30	36 66	30 10	121 18	17 35	392 96	13 92	.....	.....	.....	1,453 47	880 81
November.....	373 95	43 38	49 23	72 25	.....	100 19	19 88	8 00	.....	.....	686 88	1,082 50
December.....	196 10	41 87	57 64	124 62	41 70	240 53	13 08	22 00	4 00	.....	741 54	1,190 94
Totals.....	\$6,167 50	\$813 04	\$746 80	\$1,307 89	\$797 35	\$8,351 84	\$228 97	\$100 00	\$68 00	\$327 60	\$18,906 99	\$14,091 84

TABLE IV.

FINANCIAL STATEMENT—LOWELL WATER WORKS, 1899.

SUBDIVISION OF "PAY ROLL AND SALARIES" FROM TABLE 2.

	Salaries President and Superin- tendent	Office and Inspec- tors	New Meter Work	Meter Repairs	Exten- sion and Con- struction	Engin- eer- ing	Pumping Stations				Main- tenance	Reser- voir	Relaid Services	New Services	Re- charged Sundry Persons	Totals	
							Station 1	Station 2	Station 3	Station 4						1899	1898
January....	\$183 33	\$437 40	\$ 22 00	\$ 13 75	\$160 62	.....	\$470 72	\$437 11	\$ 81 79	\$358 42	\$1,357 91	\$46 04	.....	\$ 5 89	\$ 41 50	\$3,846 48	\$4,820 46
February...	183 34	609 86	.....	89 50	76 70	\$249 25	583 50	523 70	125 29	376 36	1,186 41	46 04	.....	.....	15 00	4,065 04	3,337 63
March .....	183 33	625 53	22 50	208 11	166 56	97 50	550 36	443 11	133 82	345 81	978 36	46 04	\$ 12 75	.....	34 87	3,888 65	3,515 24
April.....	183 33	810 25	126 00	198 78	217 74	84 00	588 07	588 55	76 95	430 44	1,647 70	57 55	66 02	254 17	42 50	5,372 05	5,362 59
May.....	183 34	648 20	70 00	125 94	730 53	84 00	478 79	497 61	.....	348 19	1,561 76	57 76	146 44	182 72	11 25	5,126 53	5,087 03
June .....	183 33	648 20	96 41	188 89	307 29	168 75	461 42	506 39	82 06	392 50	1,810 19	56 00	164 32	165 01	140 14	5,380 90	5,045 38
July.....	183 33	810 25	68 25	170 17	608 44	77 00	642 09	645 53	53 00	451 25	2,218 92	57 55	214 19	235 70	75 09	6,000 76	6,466 10
August.....	183 34	648 20	55 00	148 75	525 52	87 50	446 22	279 60	366 75	363 06	1,389 89	46 04	168 89	235 58	182 81	5,067 15	5,066 12
September.	183 33	818 89	66 75	201 89	490 09	84 00	611 67	684 20	.....	446 44	1,874 63	57 55	96 92	114 35	77 50	5,818 21	4,891 96
October....	183 33	659 72	30 00	133 25	314 09	96 50	520 44	497 36	.....	363 22	1,752 29	46 04	.....	147 11	.....	4,743 35	6,815 06
November..	183 34	659 72	30 00	206 36	155 59	105 00	508 33	535 80	.....	375 08	1,691 78	46 04	.....	99 97	12 25	4,597 01	5,732 90
December..	183 33	841 81	40 00	254 75	254 79	84 00	634 65	680 52	.....	472 11	1,787 71	57 55	19 25	124 45	.....	5,457 17	6,273 16
Totals ...	\$2,200 00	\$8,488 03	\$623 91	\$1,060 14	\$4,187 96	\$1,157 50	\$6,496 35	\$6,330 48	\$919 06	\$4,092 88	\$19,257 55	\$620 20	\$828 78	\$1,564 95	\$632 91	\$59,963 30	\$62,413 63

TABLE V.

FINANCIAL STATEMENT—LOWELL WATER WORKS, 1899.

## SUBDIVISION "WATER WORKS SUPPLIES" FROM TABLE 2.

Pumping Station, No. 1, supplies.....	\$ 1,790 35
Pumping Station, No. 2, supplies.....	1,551 09
Pumping Station, No. 3, supplies.....	164 67
Pumping Station, No. 4, supplies.....	458 67
Iron pipe and specials.....	16,997 04
Hydrants.....	413 82
Gates and valves.....	408 07
Service pipe.....	1,649 71
Pig lead.....	477 00
Meters.....	5,495 45
Sidewalk boxes.....	1,217 00
Machinery and tools.....	343 99
New Shed.....	2,937 40
Miscellaneous stock.....	1,842 48
Brass castings.....	833 21
Reservoir.....	254 55
<hr/>	
Total.....	\$36,834 50

TABLE VI.

FINANCIAL STATEMENT—LOWELL WATER WORKS, 1899.  
 DETAIL OF "PRINCIPAL AND INTEREST" FROM TABLE 2.

## WATER LOAN BONDS:

Coupon No. 13, May, 1897, 10, at 20....	\$ 200 00	
No. 14, Nov., 1897, 11, at 20....	220 00	
No. 15, May, 1898, 13, at 20....	260 00	
No. 16, Nov., 1898, 44, at 20....	880 00	
No. 17, May, 1899, 985, at 20....	19,700 00	
No. 18, Nov., 1899, 966, at 20....	19,320 00	
	<hr/>	\$40,580 00

## HIGH SERVICE LOAN:

Coupon No. 35, May, 1899, 15, at 100....	\$1,500 00	
No. 36, Nov., 1899, 15, at 100....	1,500 00	
	<hr/>	\$3,000 00

## NOTES:

Lowell Inst. for Savings, 6 mos., \$18,000 00	}	\$ 600 00	
6 mos., 12,000 00			
1 year, 30,000 00		1,050 00	
1 year, 36,900 00		1,476 00	
1 year, 40,000 00		1,600 00	
		<hr/>	\$4,726 00

## COMMONWEALTH OF MASS.:

1 year, \$60,000 00	\$2,400 00	
	<hr/>	\$2,400 00
		<hr/>
		\$50,706 00

## PRINCIPAL PAYMENTS:

Engine Loan.....	\$ 6,000 00	
Driven Well Loans.....	10,000 00	
Driven Well Loans.....	5,000 00	
Driven Well Loans.....	5,000 00	
Driven Well Loans.....	4,100 00	
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		\$80,806 00

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## TABLE VII.

## FINANCIAL STATEMENT—LOWELL WATER WORKS, 1899.

## MAINTENANCE AND CONSTRUCTION STATEMENT.

## MAINTENANCE.

## PAID FOR LABOR:

Salary President and Superintendent .....	\$ 2,200 00
Office and Inspectors.....	8,488 03
Pumping Stations.....	18,448 37
Reservoir .....	620 20
Meter Work.....	2,577 05
General Maintenance.....	20,665 08

## PAID FOR MATERIAL:

Output as per Stock Book.....	1,631 99
Interest.....	50,706 00
General Expense.....	2,570 32
Stable...:.....	1,228 33
Machinery and Tools.....	343 99
Pumping Station Supplies.....	3,964 78
Coal.....	16,015 65
Reservoir .....	254 55

Total.....	\$129,714 34
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## CONSTRUCTION.

## PAID FOR LABOR:

Extension, Construction and New Services....	6,331 66
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## PAID FOR MATERIAL:

Output as per Stock Book.....	5,382 45
Payment on Loans .....	30,100 00
Land.....	2,250 00
Storage, Shed etc. ....	2,937 40

Total.....	\$47,001 51
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# Superintendent's Report.

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LOWELL, MASS., Jan., 1st, 1900.

*To the Lowell Water Board:*

GENTLEMEN,—Following is the Superintendent's Annual Report of the general condition of the Water Works, together with other matters appertaining thereto, for the year 1899, as commanded by City Ordinances.

The total net quantity of water pumped for the year was 2,659,052,210 gallons, an excess of 206,212,843 gallons over the year 1898. This immense volume of water was taken exclusively from our system of wells; no difficulty was experienced in obtaining a sufficient supply for all demands, excepting for about two weeks last January, when a long continuous spell of severe cold weather caused an unprecedented consumption. During those two weeks, however, the wells were tested to their utmost capacity and if the low temperature then existing prevailed another week, the filter gallery

would have to be called into requisition; or if the season previous had been as dry as the last summer and fall, it would be extremely doubtful as to whether the Department would be able to meet the emergency without resorting to the use of river water to help out the supply. What the outcome will be this winter if a repetition of last year's cold snap occurs is a matter of serious concern. One thing is obvious, that with the pumpage of water increasing annually, as shown in the foregoing figures, in periods of extraordinary consumption the present number of wells cannot be relied upon to supply the demand; especially so, when the limited storage capacity of the reservoir is considered.

Of the total quantity of water consumed during the year, viz.: 2,659,464,909 gallons, more than half or 1,596,948,580 gallons was drawn from the Boulevard wells. The reason for drawing so large a proportion of the supply from this source was owing to the report of the State Board of Health that the water from these wells acted less rapidly on lead pipe than the water from the Cook and Hydraulic wells. Otherwise this plant would not have been run so hard.

#### QUALITY OF THE WATER.

During the year there was the usual number of complaints about rusty and roily water, which

were due to a variety of causes, chief of which, as you are aware, is inherent in the system of direct pumping into the distributing mains.

Every report of bad water is investigated and an effort made to remedy the trouble. Sometimes relief is given by blowing out the hydrants in the street or locality where the complaint comes from. Occasionally the fault is traced to an old iron service pipe which, when replaced by a new one delivers good water. A singular thing in connection with these complaints of bad and rusty water, is that it frequently happens that while the water is really unfit to use in one house, all the other people in the neighborhood have first-rate water. In fact, it is very rarely found that the water is unsatisfactory through a whole street; the nearest approach to it being on upper Merrimack Street between Cabot and Pawtucket Streets. There about all the residents suffer more or less from muddy and rusty water, and repeated blowing out of the hydrants affords but slight relief. The trouble here is peculiar; the street main is a large one, 12 inches in diameter. There may be a depression or several of them in the line where sediment accumulates to be subsequently dislodged and forced into the service pipes. Then also, it is a long line of pipe without branching into side streets. Possibly, if connecting pipes were laid from it through Decatur Street to Salem

Street and through Spaulding to Moody Street, an improvement might result.

During the past summer, owing to an accident to the high service pump causing its stoppage, the people living on the heights of Belvidere and Centralville using city water were afflicted with a dose of Algea, which gave the water a very obnoxious odor and taste for a few days. Aside from this accident, by furnishing the water direct from the pumps all other trouble from Algea was avoided.

Despite the complaints of the water mentioned, which are due to the conditions attending its distribution, chemically and bacterially it is as good as the best spring water, and if it were not for its solvent action upon lead as developed by the investigations of the State Board of Health, no better water could be desired. It is both palatable and wholesome as it comes from the wells.

#### MAINTENANCE.

In all corporations and large business concerns, the word "maintenance" covers a multitude of things; so in the conduct of a water works plant it is also responsible for many expenditures, and one of the most important expenditures charged to maintenance being the cost of pumping, it follows that whatever tends to reduce that cost, is a

move in the right direction. Accordingly, with that end in view, it was deemed advisable to again use the Morris engine at Pumping Station No. 1. So that in the event of the High Duty Worthington becoming disabled (which subsequently happened) it could be run instead of the Low Duty Worthington, thereby making a material saving in coal. Thus, after being out of commission three years, it was started May 5th and run during the year 110 days, pumping 453,013,120 gallons. While in operation it proved economical in the use of steam but was not so efficient in other respects. Many repairs were found necessary in order to keep it available. First the packing on the flanged head of the receiver had to be renewed; another time the key and gib connecting plunger and bucket on water end got loose; again, the starting lever broke. At present it is stopped on account of the imperfect working of the high pressure steam valves.

At this station the High Duty Worthington, which has done almost all of the pumping since it was built in 1892, had to be shut down for several weeks owing to the compensating cylinders on No. 1 side of the pump leaking. Both cylinders were found to be split and in a way that didn't admit of repairing, so two new ones were ordered of Henry R. Worthington, the builder of the pump.

Considerable delay was made in filling the order, so while the pump was stopped, the heads on the low pressure cylinder were taken off and the cylinders examined. They appeared to be in good condition, but the ring packing on the pistons were stuck so solidly in the grooves that three of them were broken in removing.

For many years the filling and varnishing which was put on the front wall of the engine room has been scaling and peeling off. The past year this was all scraped and re-done with the best stock and in a careful, painstaking manner. The rest of the walls, windows and floor were also touched up, making a great improvement in the looks of the room.

At Pumping Station No. 2, a condensor and vacuum pump purchased of the Lowell & Suburban Street Railroad has been set up and piped and is now ready for use.

Pumping Station No. 3 being closed most of the year, very little repairs were made.

At the Boulevard Station, No. 4, very little was done, excepting the enlarging of the coal bin so as to hold nearly a year's stock of coal. A platform scales should be set at this station similar to those at the other stations; then all the coal could be weighed as received by the Department.

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The wells at the three plants were cleaned last spring by pumping, tripping and flushing each individual well and much benefit was derived therefrom, particularly at the Boulevard plant, where it was again repeated in the fall, each time increasing the yield from the wells over a million gallons, also decreasing the lift on the pumps. Numerous other minor repairs and improvements were made in the pumping outfit, such as renewing valves and valve springs in the pumps, changes in piping, rebuilding fire boxes, etc.

An inspection of the filter gallery and conduit was made November 12, when the following conditions were noted. Filter gallery, every thing all right, bottom and sides clear and clean. Brick conduit between inlet chamber and White Street, brick work covered with a coating 1-4-inch thick.

Main tunnel has large deposits of matter precipitated from the water. Sand tunnel and terminal chamber in good condition. Beside the coating observed in the brick conduit, the following defects in the brick work were also noticed. Beginning at the centre of manhole on Third Avenue west of Mammoth Road, running toward White Street, from 200 to 300 feet depression on top, 390 feet large leak on east side, 420 feet, another leak on the same side, from 440 to 490 feet, bad depression, circle flattened downward; at 587 feet accumulation of fine sand indicating a

leak from the bottom, about 100 feet further along a number of bricks on the side were found loose. At the time of this examination, a large amount of sediment was taken out of the inlet chamber, but the pumps at the Boulevard could not be kept stopped long enough to allow for cleaning the conduit. It was, however, flushed out somewhat by the water from the gallery through the blow off at Beaver Brook.

Some unauthorized person took the liberty during the last summer of removing the 3-inch plank covering from the two brick wells which surround the 30-inch gate and manhole on the conduit near Beaver Brook, thus putting the Department to the expense of replacing the same. The police were notified about the depredation and if the guilty party was discovered, they would be severely prosecuted.

According to the instructions of Your Honorable Body, more than the usual amount of work was done at the reservoir the past year. The stable and hennery near the keeper's house were removed and the land where they stood graded to conform with the rest of the grounds. An addition was built to the keeper's house for a dining room and the whole house was thoroughly renovated and painted inside and out. That part of the reservoir lot facing on Beacon Street was beautified by six large flower beds, placed at suit-

able intervals along the front between the bank and the street. The attention required by these plants and the necessity of keeping the grass mowed along this front, together with the care of the several lots of land over the conduit in Pawtucketville required the services of a man during the season.

The general condition of the works and plant is good, but in order to so maintain it demands constant attention and expense.

A large portion of the property and equipment of the Department is of such a character that if neglected, it deteriorates rapidly, and a greater outlay is required to restore the same, than if properly cared for in the beginning.

Besides the painting heretofore mentioned, all of the buildings of the Department in Centralville, including the Pumping Station, coal shed, shop, stable, carriage shed and Superintendent's house were painted; also the exterior and interior of Pumping Station No. 2. Two coats of black rubber paint were applied to all the hydrants and fountains in the city. A new 5-foot picket fence was built along the front of the Department land on Plain Street and extending southerly between this same land and land of Quimby and Daniels; this fence was also painted.

In addition to the regular cleaning of the drinking fountains fifteen times during the year, 72

extra trips were made for changes and repairs. Other items of street work were done as follows: Sixty-three new iron gate boxes set, one wooden gate box and 70 wooden hydrant boxes set, 146 iron service boxes set, 68 1-foot, 36 2-foot and 3 3-foot extensions were made to service boxes, 3 broken gate frames were replaced with new and 13 leaks were dug up and repaired and 122 old services were relaid with new pipes.

For the purpose of cleaning the mains of the city, they were given a thorough blowing off or flushing three times during the year; for the same reason, also, 153 hydrants were blown off.

#### EXTENSIONS.

The extensions of street mains last year amounted to 7847 feet, making a total to date of 126.41 miles of cast iron main pipe now in use.

In connection with this work, the number of fire hydrants has been increased to 1155, of which 67 are private and 11 Lowry Hydrants, 22 street stop gates were also set, making a total of 1166 gates in service.

Fire services were laid during the year as follows:—

Wamesit Power Company, Lawrence Street, near Mattress Factory, 8-inch pipe.

Massachusetts Mohair Plush Company, Western Avenue, just west of Railroad Crossing, 6-inch pipe.

Pead's Linen Mill, West Adams Street, 4-inch pipe.

Less than the usual amount of cast iron pipe was used during the year. The inventory accompanying shows 575 tons more in stock than at the close of the year 1898. This is accounted for by the purchase of a larger amount than necessary in anticipation of an advance in the price; but although bought and paid for in 1899, will not accrue to the credit of the Department until another year.

#### SERVICES.

The effect of the city water on lead pipe as demonstrated by the tests of the State Board of Health has made the matter of services one of great importance. Heretofore for the last 15 years lead pipe was used almost exclusively for house supply, and it was believed to be the best pipe for that purpose. Now, in the light of what the State Board has developed in their investigations, there seems to be serious doubt as to its further availability as a conductor of water from a sanitary point of view. Due to the agitation over this subject, 15 new plain iron services and 20 tin-lined iron services were called for and laid. This tin-

lined pipe consists of a block tin pipe drawn through and secured to the inside of a wrought iron pipe. It has the approval of the State Board of Health and is undoubtedly a splendid pipe for service work. Frequently it happens that in lanes and short streets it becomes advisable to lay 1 1-2-inch and 2-inch pipe. In such cases, and also where large services are called for, cement-lined iron pipe could be used to advantage. The number of new services laid last year was 167. Total now in use, 10,529.

Number of new meters set last year 413, total now in use 5268. Further details regarding services and meters are furnished in the accompanying tables.

## METERS RUNNING January 1, 1900.

Sizes	5-8-in.	3-4-in.	1-inch	<sup>1</sup> 1-2-in.	2-inch	3-inch	4-inch	6-inch	Total
Desper - -	49	29	8	--	--	--	--	--	86
Crown - - -	2119	1520	271	13	16	2	5	2	3948
Worthington	180	26	51	65	31	7	3	--	363
Duplex - -	7	9	7	--	--	--	--	--	23
Ball & Fitts	2	--	--	--	--	--	--	--	2
Frost - - -	3	6	1	--	--	--	--	--	10
Thomson -	6	20	3	--	--	--	--	--	29
Gem - - -	--	--	--	--	5	--	2	2	9
Metropolitan	--	2	--	--	--	--	--	--	2
Trident - -	99	23	1	--	--	--	--	--	123
Nash - - -	73	64	42	--	--	--	--	--	179
Lambert - -	56	55	7	--	--	--	--	--	118
Niagara - -	1	1	--	--	--	--	--	--	2
Hersey - -	154	54	4	1	--	--	--	--	213
Empire - -	65	28	2	--	--	--	--	--	95
Westinghouse	--	1	--	--	--	--	--	--	1
Columbia -	47	--	--	--	--	--	--	--	47
Unio. - - -	16	1	--	1	--	--	--	--	18
Total - - -	2877	1839	397	80	52	9	10	4	5258

# REPORT OF THE WATER BOARD

## PRIVATE METERS RUNNING January 1, 1900.

Sizes					3-8-in.	5-8-in.	3-4-in.	1-inch	2-inch	Total
Desper	-	-	.	-	-	1	3	1	-	5
Worthington	-	-	-	-	-	-	-	1	2	3
Crown	-	-	-	-	1	22	22	2	-	47
Columbia	-	-	-	-	-	1	-	-	-	1
Duplex	-	-	-	-	-	1	-	-	-	1
Hersey	-	-	-	-	-	3	-	-	-	3
Thomson	-	-	-	-	-	-	1	-	-	1
Nash	-	-	-	-	-	11	2	-	1	14
Frost	-	-	-	-	-	2	1	-	-	3
Empire	-	-	-	-	-	2	-	-	-	2
Trident	-	-	-	-	-	1	-	-	-	1
Lambert	-	-	-	-	-	3	-	-	-	3
Total	-	-	-	-	1	47	29	4	3	84

New meters set	.	.	.	.	.	.	.	413
Meters condemned	.	.	.	.	.	.	.	46
Meters cleaned and repaired	.	.	.	.	.	.	.	674
Meters frozen and burst	.	.	.	.	.	.	.	100
Meters discontinued	.	.	.	.	.	.	.	5
Meters set for private use	.	.	.	.	.	.	.	3
New meters set in place of old ones condemned	.	.	.	.	.	.	.	53



1. 40X  
2. 100X  
3. 1000X



## NEW SERVICES.

3	5-8-inch Lead Pipe	.	.	153 feet
22	3-4-inch Lead Pipe	.	.	754 feet
1	1-inch Lead Pipe	.	.	57 feet
2	3-4-inch Iron Pipe	.	.	763 feet
10	1-inch Iron Pipe	.	.	413 feet
3	2-inch Iron Pipe	.	.	259 feet
95	3-4-inch Iron Lead Lined	.	.	3,487 feet
3	1-inch Iron Lead Lined	.	.	80 feet
6	1 1-2-inch Iron Lead Lined	.	.	576 feet
1	2-inch Iron Lead Lined	.	.	40 feet
1	1-inch Iron Galvanized	.	.	350 feet
16	3-4-inch Iron Tin Lined	.	.	530 feet
4	1-inch Iron Tin Lined	.	.	181 feet
<hr/>				
167				7,643 feet

Amount previously laid	.	405,766 feet
Total now laid	.	413,409 feet
Total services laid	.	11,227
Total cut off at main	.	745
Total reconnected	.	47
Total now in use	.	10,529

SERVICES CHANGED.

No	Kind	Changed to												Total feet
		Lead 5-8-in.	Lead 3-4-in.	Lead 1-in.	Lead lined 3-4-in.	Lead lined 1-in.	Lead lined 2-in.	Iron 3-4-in.	Iron 1-in.	Iron 2-in.	Tin lined 3-4-in.	Gal. Iron 1 1-4-in.	Brass 1 1-2-in.	
6	3-4-in. iron.....	117.9												117.9
25	3-4-in. iron.....		695.0											695.0
1	3-4-in. iron.....			22.3										22.3
54	3-4-in. iron.....				1581.9									1581.9
1	3-4-in. iron.....											20.8		20.8
8	3-4-in. iron.....								327.3					327.3
2	3-4-in iron.....										95.3			95.3
6	1-in. iron .....		174.0											174.0
5	1-in. iron .....				153.3									153.3
1	1-in. iron .....					7.6								7.6
5	3-4-in. iron.....					167.6								167.6
11	1-4-in. iron.....						216.6							216.6
11	1-4-in. iron.....													53.0
11	1-2-in. iron.....									53.0			24.6	24.6
1	2-in. iron .....		35.6											35.6
1	5-8-in. lead.....								33.6					33.6
1	3-4-in. lead.....								13.2					13.2
11	1-in. lead lined .....							176.6						176.6
11	1-in. lead lined .....								31.0					30.0
122	Total .....	117.9	904.6	22.3	1735.0	175.0	216.6	176.6	404.11	53.0	95.3	20.8	24.6	3945.10

## SUMMARY.

Quantity of water pumped at Pump-		
ing Station No. 1 . . . .	1,596,948,580	Gallons
Quantity of water pumped at Pump-		
ing Station No. 2 . . . .	965,247,229	"
Quantity of water pumped at Pump-		
ing Station No. 3 . . . .	96,856,401	"
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Total net pumpage . . . .	2,659,052,210	"
Quantity pumped into High Service .	50,590,456	"
Quantity pumped at Pumping Sta-		
tion No. 4 . . . .	1,667,162,640	"
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Total gross pumpage . . . .	4,376,805,306	"
Estimated quantity of water syphoned		
from Pumping Station No. 3		
and pumped at Pumping Sta-		
tion No. 2 . . . .	270,988,000	"
Total coal consumed for the year .	5,198 <sup>808</sup> / <sub>2000</sub>	tons
Total expense of pumping . . .	\$39,175	35
Average cost of pumping a million		
gallons based on expense of		
pumping . . . . .	\$14	73
Total cost of maintenance and in-		
terest . . . . .	\$129,714	34
Total paid for interest . . . .	\$50,706	00
Average cost of a million gallons		
based on maintenance and in-		
terest . . . . .	48	78
Total expenditures . . . . .	\$202,012	78

Total receipts . . . . .	\$202,421 50
Total consumption of water . . .	2,659,464,909 Gallons
Average daily consumption . . .	7,286,205 "
Per capita consumption based on 90,000 population . . . . .	81 "
Excess of consumption over 1898 .	204,889,644 "
Price received for a million gallons of water based on total receipts and consumption . . . . .	\$76 11
Price charged for million gallons of water per meter rate of 14c. per 100 cubic feet, 10 per cent. off . . . . .	\$167 96
Total number of services in use .	10,529
Total number of meters in use .	5,268
Total length of cast iron mains .	126.41 miles
Total number of fire hydrants .	1,155
Total Water Works debt . . .	\$1,229,800 00
Amount in Sinking Fund . . .	\$273,623 35
	<hr/>
	\$956,176 65

The storage shed built on Jewett Street, under authority of Your Honorable Board, and the concreting of the yard in connection therewith is a very decided improvement; and affording as it does, an opportunity of housing and sorting the multiplicity of special castings used on the works, it cannot fail to be of inestimable convenience.

The recommendation of the State Board of Health that the valley of Beaver Brook near the New Hampshire state line be tested for ground water by means of driven wells, is by your instructions now in progress.

Probably many other matters pertaining to the conduct of the Works might be told or what has been mentioned could be more minutely described, yet I have endeavored, to the best of my ability, to set forth by tables and summary the affairs of the Department clearly and concisely.

Last fall, several photographs were taken of the reservoir, lands, buildings, etc., of the Department, and I would like to see them printed in the Annual Report. It would tend to make it more complete, interesting and instructive. Many of our citizens have but a faint idea of the extent and value of the Water Works system. To such people, these views would be a revelation, and no doubt make a favorable impression. As a form of record, they cannot be surpassed, and for that reason it would be wise to preserve them and that can be most effectively done by having them made a part of the Report.

Before concluding, I desire to testify to the ability and efficiency of the clerk, J. W. Crawford; and also I beg leave to say that of the many Water Boards I have had the honor of acting

with in the past, none has given me more pleasure to serve individually and collectively, than the present Board.

With the assurance, gentlemen, that I heartily appreciate your kindness and co-operation, this Report is

Respectfully submitted,

ROBERT J. THOMAS,

Superintendent.



LOW SERVICE—WATER PIPES LAID IN 1899.

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LOW SERVICE—WATER PIPES LAID IN 1899.—*Continued.*

			135			
Wamesit P'rCo	Fire service off Lawrence st Matt- ress and Box Shops (Private)..					585.0
Warwick.....	Connection between B. and D.....'					164.5
West Adams..	Fire service to Pead's linen mill... 18					18.0
West Eleventh	West'y and south'y to Clough ave .					97.0
Western Ave..	Fire service to Mass. Mohair Plush Co.....					18 0
Whidden ....	Southerly to St. James.....					50.0
Whitney Ave.	Northerly to Eighteenth st. ....					233.0
Winthrop Ave.	Westerly for hydrant.....					6.0
	Hydrants.....					56.0
Laid in 1899.		18	0167½	414	309	6908.5





## HIGH SERVICE—WATER PIPES LAID IN 1899.

STREETS	BETWEEN WHAT STREETS.	Length in feet.					Total.
		4-in.	6-in.	8-in.	10-in.	12-in.	
Birch .....	Extended westerly .....		259				259.0
Fremont .....	Northerly to Tenth st. ....		379½				379.5
Tenth .....	Northerly from Mt. Pleasant. ....		322				322.0
	Laid in 1899 .....		978½				978.5
	High service laid previous to 1899 .						36,317.0
	Total high service to Jan. 1, 1900. .						37,295.5

Brought forward .....	6,968.5 feet
Low service laid previous to 1899 .....	623,283.5 "
Total low service to January 1, 1900 .....	630,252.0 "
Total high service to January 1, 1900 .....	37,295.5 "
Total high and low service to January 1, 1900.	667,547.5 "
Total in mile, 126.43.	

## LOW SERVICE—LIST OF STOP GATES SET DURING 1899.

STREETS.	LOCATION.	4-in.	6-in.	8-in.	10-in.	12-in.
Am. Woolen Co. ....	On 8-inch hydrant connection between American Woolen Co. and Sterling mills. (Private).....			1		
Am. Woolen Co. ....	On 8-inch hydrant connection at coal shed. (Private)			1		
Am. Woolen Co. ....	On 8-inch line basement stairway. (Private) .....			1		
Avon .....	12 feet east of west line Avon street, on south line Seventh avenue.....		1			
Barker Ave. ....	33 Barker street.....		1			
Clough Ave. ....	10 Clough avenue, on east .....		1			
Cornell.. ..	12 feet west of east line Cornell, on north line Princeton street.....		1			
Corner ...	12 feet south of north line Corner street, on west line of South Walker street.....		1			
D.....	13 1-2 feet south of north line D street, on east line School street.....		1			
Eighth.. ..	10.6 feet south of north line Eighth street, 17 feet west of east line Bridge street.....		1			
Fifth Ave.,...	13 feet north of south line and Fifth avenue, on west line Moody street.....		1			
Hadley .. .	12 feet west of east line Hadley, on south line Princeton street .....		1			
Hall.....	On at T. & S. mills, 7.5, 1, 10 feet west of east .....		1			
Hazeltine .....	10 line Hazeltine street, on east street.....		1			
Inland.....	12 feet north of south line Inland street, on west line Blodgett street .....		1			
Lawrence. ....	On fire service to Wamesit Power Co., 74 1-2 feet south of south line Randolph street, 34.7 feet west of west line .....			1		
Mt. Hope . ....	27.5 feet line street, on south .....		1			
Old Meadow Road. ..	15 line Mammoth Meadow Road, on west .....		1			
Puffer.. ..	12 1-2 feet west of east line Puffer street, on north line A street .....		1			
Richardson .. .	14 h line Richardson street, on east line Hildreth street .....		1			
Sanders Ave .	12 feet east of west line Sanders avenue, on south line Davenport east .....		1			

LOW SERVICE—LIST OF STOP GATES SET DURING 1899.

*Continued.*

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LOW SERVICE—LIST OF HYDRANTS SET DURING  
THE YEAR 1899.

STREETS.	LOCATION.
Baldwin .....	Westerly side, end of pipe. (Change).
Cornell.....	Easterly side, cor. Princeton street.
Emery .....	Southerly side, end of pipe.
Gersham Ave .....	Northerly side, east of Woodcock street. (Change).
Inland.....	Southerly, on end of pipe.
McKinley Ave .....	Northerly side, on end of pipe.
Nelson.....	Easterly side, on end of pipe. (Change).
Sanders Ave.....	Westerly side, on end of pipe.
Wamesit Power Co. ....	Near tank at Box Shop. (Private).
Wamesit Power Co. ....	In front of United States Cartridge Co. In house. (Private).
Winthrop Ave.....	Northerly side, on end of pipe. Opp. No 57.



HIGH SERVICE—LIST OF STOP GATES SET DURING THE YEAR 1899.

STREETS.	LOCATION.	4-in.	6-in.	8-in.	10-in.	12-in.
Tremont .....	13 feet west of east line Fremont street, 22 feet north of south line Tenth street.....		1			
Tenth .....	35 feet west of east line Mt. Pleasant street, on north line Reservoir lot.....		1			

LOW SERVICE—WATER PIPES LAID IN 1899.—Continued.

STREETS.	BETWEEN WHAT STREETS.	Length in feet.					Total.
		4-in.	6-in.	8-in.	10-in.	12-in.	
	Brought forward . . . . .	444	127	251			822 0
Sanders Ave .	Southerly from Davenport E. . . . .	314					314 0
Sherman . . .	Fire services to Sterling and Am. Woolen Co. mill Brook crossing (Private) . . . . .			17	104		121 0
Stevens. . . .	Southerly to Belle ave . . . . .		12	135			147 0
St. James. . . .	Easterly from Whidden . . . . .	217					217 0
Victoria . . . .	Extended westerly. . . . .	142					142 0
Waite. . . . .	Westerly to Powell . . . . .	420		135			555 0
Wamesit PrCo	Fire service off Lawrence st Mattress and Box Shops (Private). . . . .	104 1/2					104 3/4
Warwick. . . .	Connection between B. and D . . . . .						104 3/4
West Adams..	Fire service to Pead's linen mill . . . . .	18					18 0
West Eleventh	West'y and south'y to Clough ave . . . . .	97					97 0
Western Ave.	Fire service to Mass. Mohair Plush Co. . . . .	18					18 0
Whidden . . . .	Southerly to St. James . . . . .	50					50 0
Whitney Ave.	Northerly to Eighteenth st . . . . .	233					233 0
Winthrop Ave.	Westerly for hydrant . . . . .	6					6 0
	Hydrants . . . . .	56					56 0
	Laid in 1899.	18	6157 1/2	414	320		6809 3/4



## STOCK ON HAND JAN. 1, 1900.



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One 10-inch flange gate, 2 lengths 24-inch flange pipe, 3 lengths 12-inch flange pipe, 11 lengths 10-inch, 1 length 8-inch, 6 lengths 6-inch, 7 lengths 4-inch.

Flange Specials. Fourways, 1 8-inch x 6-inch x 6-inch x 4-inch. Threeways, 2 8-inch x 6-inch x 4-inch, 5 10-inch x 8-inch x 4-inch, 9 8-inch x 8-inch x 4-inch, 1 6-inch x 6-inch x 4-inch, 1 12-inch x 12-inch x 20-inch, 5 16-inch x 12-inch x 12-inch, 10 2-inch x 2-inch x 3-inch, 1 20-inch x 20-inch x 12-inch, 2 4-inch 1-4 turn, 1 8-inch 1-8 turn, 2 8-inch 1-4 turn.

Cast Iron Pipe in Pieces. Thirty-inch, 6-foot; 24-inch, 59-foot; 20-inch, 64-foot; 16-inch, 36-foot; 12-inch, 56-foot; 10-inch, 33-foot; 8-inch, 76-foot; 6-inch, 37-foot; 4-inch, 72-foot; 1 30-inch manhole, 1 30-inch clamp sleeve, 1 24-inch clamp sleeve, 8 Ludlow hydrants, 1 Chapman hydrant fourway, 1 Boston Post hydrant, 1 Lowry hydrant, 11 flush hydrants, 60 iron gate boxes, 24 logs for blasting, 3000 foot 4-inch x 4-inch spruce lumber, 1 6-inch check valve.

STOCK ON HAND JAN. 1, 1900.

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## PROPERTY AND TOOLS AT SHOP, HAMPSHIRE STREET.

One 8 x 10 plain slide valve engine, 1 10-foot engine lathe, 1 7-foot engine lathe, 1 6-foot brass finishing lathe, 1 5-foot speed lathe, 1 shaper, 1 upright drill, 1 emery wheel, 1 grindstone, 2 soldering furnaces, 1 large end chuck, 2 independent chucks, 2 drill chucks, 10 lathe dogs, 20 reamers, 10 twist drills, 8 flat drills, 12 flat chucking drills, 42 turning tools, 10 steel arbors, 2 reamers for Desper meters, 21 taps, 3 tap wrenches, 1 hand vise, 4 vises, 2 pipe vises, 1 wagon vise, 1 large platform scale, 3 small platform scales, 1 Smith tapping machine, 1 shaft hanger, 44 tools for brass lathe, 12 sets, 13 cast iron chucks, 1 set hand chasers, 1 set brooches, 25 tools for brass work, 1 set wood patterns for sidewalk cocks, 1 set 1-inch patterns for sidewalk cocks, 1 set 1-inch patterns for corporation cocks, 1 wood pattern complete for 2-inch plug cocks, 1 wood and 2 brass patterns for handles for 1-inch cocks, 1 gate of 4 brass patterns for 3-4-inch sidewalk cocks, 1 gate of 4 brass patterns for 3-4-inch corporation cocks, 1 gate of four brass patterns for plugs for 3-4-inch sidewalk cocks, 1 gate of 4 brass patterns for 3-4-inch cellar cocks, 1 gate of 4 brass patterns for tail pieces for 3-4-inch cocks, 1 gate of 4 brass patterns for smooth tail pieces, 1 gate of 4 brass patterns for washers for 3-4-inch cocks, 1 gate of 4 brass patterns of nuts for 3-4-inch cocks, 1 gate of 4 brass patterns for 1-3-inch x 1-2-inch couplings, 1 gate of 4-inch brass patterns for 3-4-inch thimbles, 2 large wood patterns for heads of pumps, 1 wood pattern for packing box of high service engine, 2 large wood patterns for nuts, 2 plunger rods for pumps, 1 Gow meter testing machine, 1 Howe scale with tank for testing meters, 11 Stillson wrenches, 9 S wrenches, 13 flush hydrant wrenches, 8 post hydrant wrenches, 10 gate wrenches, 5 tapping machines and rubbers, 6 taps and drills, 3 tap wrenches, 1 set plumbers' tools, 3 naphtha furnaces, 1 pair round nose pliers, 15 files, 2 soldering irons, 3 screw drivers, 2 dust pans, 4 oil cans, 1 large oil can, 1 set of bits, 1 bit stock, 1 set chisels, 1 belt punch, 1 set steel figures, 2 cut nippers, 1 naphtha can, 2 hack saws, 1 clock, 1 pair scissors, 1 pair snips, 1 saw set, 2 gate plans, 1 desk, 1 marlin spike, 2 naphtha lamps, 1 Lowell Water Works seal, 1 set tools for sealing fire services, 2 tool bags, 1 step ladder, 1 map of water mains,







1 chair, 3 stools, 1 floor brush, 1 mirror, 1 can of glue, 1 waste can, 1 pipe bench, 1 nozzle, 2 dutchmen, 6 lbs. iron wire, 10 lbs. brass rod, 5 lbs. copper wire, 1 lead reel, 1 pipe rack.

#### PROPERTY AT SUPERINTENDENT'S OFFICE.

Three desks, 3 chairs, 1 set of drawers and bookcase, 1 small bookcase, 1 Howard electric clock, letter press, 1 gate plan, 2 diagrams, 1 picture, 3 bill files, 1 water gauge, 1 test gauge, 2 ink-stands, 1 feather duster, set of ward maps.

#### PROPERTY AND TOOLS AT EXPERIMENTAL WELLS ON BEAVER BROOK.

One axe, 2 pails, 1 stove, 1 tool shed, 2 36-inch Stillson wrenches, 1 14-inch monkey wrench, 1 12-inch monkey wrench, 1 14-inch Stillson wrench, 2 large pipe tongs, 2 small pipe tongs, 1 2-inch die-stock and die, 1 2-inch pipe cutter, 4 Pitcher pumps, 1 force pump, 1 broom, 1 3-4 inch diestock and die, 1 well driver complete.

#### PROPERTY AND TOOLS AT TOOL HOUSE.

One length 6-inch cast iron flange pipe, 30 feet 6-inch wrought iron pipe, 20 feet 4-inch wrought iron pipe, 2 6-inch elbows, 1 6-inch 1-8 curve, 1 4-inch elbow, 1 6-inch Lee 14-foot 4-inch soil pipe, 1 12-inch elbow, 76 3-4-inch sidewalk boxes, 22 1-inch sidewalk boxes, 34 2-inch sidewalk boxes, 72 feet 2-inch old wrought iron pipe, 1 stone drag, 8 caps for sidewalk boxes, 25 cedar posts, 400 old bricks, 1 lawn roller, 4 derricks, 1 iron part of drinking fountain, 1 drinking fountain complete, 5 cords of wood, 2 saw horses, 6 old wheelbarrows, 1 pipe testing machine, 5 meter box covers, 1 sluice gate, 7 covers and frames for gate boxes, 180 feet 4-inch x 4-inch kyanized spruce lumber, 2 coke furnaces, 150 feet 3-4 inch sheating, 66-foot fence rails, 7 bridge bolts, 1 rubber wagon spring, 1 3-foot extension, 21 2-foot extensions, 30 extension plugs, 1 square iron gate box, 2 pipe benches, 4 2-inch iron tees, 2 mortar boxes, 2 old gate tops, 5 old gate bottoms, 6 gate caps, 5 screens for gallery, 3 screens for





## PROPERTY AND TOOLS AT STATION NO. 2.

Three thermometers, 1 platform scales, 1 30-foot Howe platform scales, 1 map of City of Lowell, 1 desk, 4 chairs, 1 22-foot ladder, 1 15-foot ladder, 1 stepladder, 25 feet 1-inch rubber hose, 1 6-inch pipe cutter, 1,500 old bricks, 3 6-gallon oil tanks, 1 sprinkling can, 1 iron tube scraper, 3 lanterns, 1 stool, 25 feet rubber hose for blowing out tubes, 1 grind stone, 2 square pointed shovels, 2 vice benches, 1 work bench, 1 clock, 8 coal chisels, 3 monkey wrenches, 7 socket wrenches, 1 complete set of wrenches for steam pumps, 1 pinch bar, 2 crowbars, 3 gate wrenches, 2 striking hammers, 1 coal hammer, 1 sledge hammer, 2 long steel chisels, 3 taps, 1 axe, 1 ice chisel, 2 long handle shovels, 1 slice bar, 1 boiler hoe, 1 iron wheelbarrow, 2 lamps, 2 brooms, 1 gallon measure, 200 feet cotton hose, 3 Stillson wrenches, 3 lbs. cotton waste, 4 gals. spindle oil, 4 gals. kerosene oil, 30 gals. cylinder oil, 1 tunnel, 4 oil cans, 2 water tumblers, 5 lbs. hemp packing, 30 spindles for Dean pump, 33 valve plates, 40 springs, 2 pails, 102 4-inch rubber valves for Dean pump, 6 old brass valves, 1 small jack, 2 die stocks, 7 dies, 4 gauge glasses, 1 ratchet drill, 4 drills, 1 hand brush, 1 valve wrench, 4 fire shovels, 1 ring for water piston, 1 1-inch tap, 1 3-4-inch tap, 1 1 1-2-tap, 2 square pointed shovels, 2 long handle scoop shovels, 1 mop, 14 lbs. Knowlton ring packing, 1 scythe, 3 files, 1 pair rubber boots, 1 copper hammer, 1 cross cut saw, 1 2-foot steel square, 1 hand saw, 1-2 gal. solarine polish, 1 5-gal. oil can, 2 3-4 iron unions, 40 lbs. of brass, 5 lbs. mop waste, 2 8-inch air chambers, 1 2-inch chain tongs, 1 3-inch pipe tongs, 1 6-inch iron elbow, 1 6-inch wooden plug, 2 1-2-inch iron elbow, 3 3-inch iron nipples, 2 3-inch iron elbows, 1 3-inch x 2-inch iron tee, 1 2 1-2-inch iron union, 1 3-inch x 2 1-2-inch iron elbow, 3 hand hole plates, 2 check valves, 1 2 1-2-inch iron tee, 1 2 1-2-inch iron nipple, 1 3-inch iron coupling, 1 3-inch x 2 1-2-inch iron tee, 8 pieces pipe covering, 36 sleeves for wrought iron pipe, 30 feet 4-inch wrought iron pipe, 50 feet 2-inch pipe, 4 feet 2-inch lead lined iron pipe, 18 feet 1-inch iron pipe, 2 sets of boiler grates complete, 3 picks, 4 handles, 6 feet 10 inches of 4-inch soil pipe, 5 4-inch elbows, 200 5-foot fence pickets, 1 gate frame and cover, 4 feet 1-inch lead pipe, 2 Jenkins valves, 1 bit stock and set of bits, 1 claw hammer, 1 pair of 3-inch clamps, 8 lbs. rubberbestos

packing, 3 long steel wedges, 1 long handle scoop, 2 pair 6-inch wooden clamps, 2 garden hoes, 2 iron rakes, 1 wooden rake, 1 3-inch x 2-inch iron tee, 1 old 2-inch valve, 1 old bench vice, 1 pair 2-inch flanges, 1 6-inch iron nipple, 1 old steam trap, 2 pipe hangers, 1-2 barrel blacksmith's coal, 1 tee wrench, 1 1-2 barrel magnisia pipe covering, 1-2 barrel cement, 1 post hydrant wrench, 1 6-inch iron coupling, 1 caulking hammer, 1 machinist's hammer, 50 feet 3-4-inch rubber hose, 2 4-inch 1-4 turns, 1 8-inch 1-8 turn, 2 8-inch 1-4 turns, 53 feet 6-inch wrought iron pipe, 30 feet 4-inch wrought iron pipe.

#### PROPERTY AND TOOLS AT STATION NO. 3.

Five wrenches for Worthington pump, 1 18-inch monkey wrench, 1 12-inch monkey wrench, 1 8-inch monkey wrench, 4 Stillson wrenches, 8 socket wrenches, 3 offset wrenches, 2 3-4-inch eye bolts, 3 1-2-inch eye bolts, 2 brooms, 2 brass trays, 3 brass oil cans, 3 tunnels, 22 6-inch rubber valves, 1 dust pan, 1 brush, 6 4-inch springs, 1 8-foot ladder, 1 stepladder, 1 stand, 1 9-foot running board, 8 feet 3-8-inch rubber hose, 1 work bench, 1 platform scales, 1 iron wheelbarrow, 2 coal shovels, 1 sledge hammer, 1 slice bar, 2 boiler hooks, 1 hook bar, 2 pails, 6 drip pans, 4 brass oil cans and tray, 3 gallons kerosene oil, 1 1-2 gallon oil can, 3 lanterns, 3 B. & H. lamps, 2 large lamps, 3 bracket lamps, 2 60-gallon oil tanks, 1 waste can, 15 lbs. cotton waste, 2 5-gallon oil cans, 1 iron rake, 1 mop, 1 garden rake, 1 hoe, 1 24-inch flange, 1 2-inch scraper, 1 faucet, 1 desk, 2 axes, 1 coal hammer, 1 pipe vice and bench, 8 5-inch rubber valves, 5 brass springs for valves, 25 feet 1 1-2-inch rubber hose for blowing out tubes, 1 ink stand, 3 lamp chimneys, 1 lantern globe, 5 1-2 lbs. Knowlton packing, 2 lbs. flax packing, 3 lbs. Eureka packing, 1 diaphragm for hand pump, 1 hand hole gasket, 1 post hydrant wrench, 2 fork wrenches, 1 gate wrench, 1 diaphragm pump, 2 lengths of suction hose, 1 barrel valvolene cylinder oil, 1 quart Solarine polish, 6 gals. kerosene oil, 2 pipe cutters, 1 2-inch die stock and die, 1 machinist's hammer, 1 long steel chisel, 1 1-2-inch die, 1 1-4-inch die, 1 2-inch die, 3 2-inch couplings, 3 2-inch iron elbows, 2 1-inch iron elbows, 1 1-4-inch 1-4 turn, 2 1-inch iron unions, 2 2-inch iron nipples, 1 1-inch x 3 1-4-

inch iron tee, 2 1 1-2-inch flanges, 3 2-inch brass valves, 2 picks, 2 round pointed shovels, 1 long handle scoop shovel, 2 fire hose, 1 hand saw, 1 ice chisel, 1 coal chisel, 1 spirit level, 12 feet 5-8-inch rubber hose, 2 window sashes, 1-2 keg wire spikes, 3 2-inch flange tees.

#### PROPERTY AND TOOLS AT STATION NO. 4.

Two desks, 1 ink stand, 4 chairs, 3 small lamps, 4 large lamps, 3 lanterns, 1 whisk broom, 1 mirror, 1 gate plan, 3 thermometers, 7 10-inch x 3-4-inch gauge glasses, 24 3-4-inch gauge glass washers, 1 gauge glass for receiver, 1 bull's eye glass for receiver, 9 large lamp chimneys, 9 small lamp chimneys, 1 large lamp wick, 18 small lamp wicks, 11 sheets emery cloth, 2 2-inch valve discs, 8 1 1-4-inch valve discs, 3 1-inch valve discs, 1 3-4-inch fusible plug, 45 gals. kerosene oil, 5 gals. engine oil, 2 gals. cylinder oil, 2 60-gallon oil tanks, 1 cold chisel, 9 ratchet wrenches, 4 S wrenches, 2 spanner wrenches, 1 24-inch Stillson wrench, 1 24-inch monkey wrench, 1 12-inch Stillson wrench, 2 12-inch monkey wrenches, 16 pump wrenches, 10 packing hooks, 11 eye bolts, 1 screw driver, 1 oil set with stand, 2 hammers, 2 oil cans, 1 saw, 1 hatchet, 1 dust pan, 2 mops, 1 lever for feed pump, 1 floor brush, 15 lbs. cotton waste, 10 lbs. 1-2-inch square tuck packing, 2 lbs. 3-4-inch tuck packing, 2 lbs. 9-16-inch Daniels P. P. packing, 5 lbs. 5-8-inch Chesterton's flat gum core packing, 1 lb. 3-8-inch Garlock packing, 1 lb. 1-4-inch Garlock packing, 2 lbs. 7-8-inch x 3-4-inch Knowlton ring packing, 2 lbs. hemp, 20 lbs. Black Hawk packing, 25 lbs. sheet rubber packing, 6 studs for hand hole plates and pumps, 1-2 gallon Solarine polish, 1-2 box Solarine paste, 1 lb. tallow, 1 2-inch Chapman valve, 2 balls lamp wicking, 1 hand lamp, 1 spirit level, 7 pump valves, 1 gate wrench, 1 set of old pump valves, 1-2 cask of lime, 8 fire irons, 1 boat, 1 iron rake, 3 shovels, 2 picks, 2 coal scoops, 1 hand rake, 1 grind stone, 1 scythe and snath, 1 3-inch tube scraper, 1 blow out hose, 50 feet 3-4-inch rubber hose 1 ground hoe, 1 bench, 1 vise, 1 anvil, 1 coal barrow, 1 wheelbarrow, 2 pumps, 1 platform scales, 20 feet small chain, 50 feet 1-2-inch pipe for cleaning wells, 2 dippers, 1 coal hammer, 1 20-foot ladder, 4-foot 6-inch soil pipe, 1 hand hole gasket, 1 gauge glass cutter, 8 rubber valves for air pump, 72 fire bricks, 14 cask cement, 2-3



ness thread, 2 nickle bits, 1 pair winkers, 1 ball buttoning twine, 1-2 sheet black felt, 1-2 sheet yellow felt, 1 pair 1 3/4 inch nickle trace buckles, 2 second hand bits, 1 second hand heavy harness, 1 lb. copper rivets, 1 second-hand pair hames, 2 quarts neat's foot oil, 2 pair shaft tips, 1 paper black headed nails, 3 papers of trimmers.

#### PROPERTY AND TOOLS AT BLACKSMITH SHOP.

One forge and bellows, 1 steel square, 6 hand punchers, 31 blacksmith's tools, 14 pair tongs, 1 pair dividers, 1 work bench, 2 vises, 1 draw knife, 2 Water Works stamps, 1 portable forge, 5 closet, 5 handle punchers, 1 pair pliers, 1 grub pick, 1 coal hod, 1 coal shovel, 224 feet 1 1/2-inch drills, 89 feet 1 1/4 inch drills, 21 feet 1-inch drills, 9 spoons, 1 spanner, 1 blacksmith's saw, 1 broom, 2 tag ropes, 2 anvils, 9 cutters, 250 lbs. old iron, 45 lbs. pick steel, 80 lbs. machine steel, 39 old picks, 35 good picks, 25 lbs. Norway iron, 4 stone chains, 11 crow bars, 2 pick handles, 1 water pail, 100 lbs. blacksmith's coal, 367 unfinished nuts, 12 feet tag rope chain, 8 rock wedges, 1 file, 2 steel tunneling bars, 1 fork sidewalk wrench, 18 lbs. wrought iron, 1 tee sidewalk wrench, 1 ice tongs, 1 handle for lead pot, 1 ice chisel, 4 feet 4-inch wrought iron pipe, 83 rings for hydrant nozzle caps, 2 unfinished rings for hitching purposes, 1 stool, 500 lbs. old nuts, bolts and washers, 15 lbs. unfinished rivets, 2 iron hydrant spindles, 75 hammer wedges, 2 lbs. borax, 3 coal chisels, 1 complete set of blacksmith's tools, 4 hooks for tag rope, 2 hooks for stone chain, 15 1 1/4-inch bolts.

#### PROPERTY AND TOOLS AT RESERVOIR—[LOW SERVICE.]

One boat and oars, 2 lawn mowers, 1 scythe, 1 wooden rake, 2 garden rakes, 2 grass hooks, 1 monkey wrench, 1 long handle hoe, 1 wooden snow shovel, 1 axe, 1 ice chisel, 1 lantern, 1 garden wheelbarrow, 1 broom, 1 pail, 3 shovels, 1 long handle shovel, 50 feet 1-inch rubber hose, 1 hand saw, 1 buck saw, 1 2-gallon sprinkling pot, 1 turf cutter, 1 pair sheep shears, 1 hose reel.







## PROPERTY AND TOOLS AT INLET HOUSE.

One hoe, 1 ice dipper, 1 gate wrench, 1 ice chisel, 1 square pointed shovel, 1 ice hook, 1 pick, 1 ice rake.

## PROPERTY AND TOOLS AT GALLERY HOUSE.

Sixteen screens, 1 boat complete, 2 sets iron blocks and falls, 3 tag ropes, 1 gate wrench, 1 tee wrench, 1 snow shovel, 1 round pointed shovel, 1 square pointed shovel, 1 broom, 1 ice rake, 1 ice hook, 50 feet 1-inch rubber hose, 1 fork wrench.

## PROPERTY AND TOOLS AT BODWELL GATE HOUSE.

One round pointed shovel, 1 pick, 1 gate wrench, 8 feet 1 1-4-inch iron pipe.

## MOVEABLE FIXTURES AND PROPERTY AT OFFICE, CITY HALL.

Two roll-top desks, 2 standing desks, 1 double flat desk, 1 3-place inspector's desk, 1 2-place inspector's desk, 2 single inspector's desks, 2 heavy oak tables, 1 typewriter desk, 1 Remington typewriter, 1 small table, 1 vault table, 2 swivel upholstered chairs, 6 upholstered chairs, 12 cane seated arm chairs, 8 swivel cane seated chairs, 2 high chairs, 2 stools, 1 step chair, 1 settee, 1 bookcase, 2 water-pressure gauges, 2 thermometers, 1 clock, 2 table gas lamps, 33 framed pictures—plans, etc.; 2 floor rugs, 1 rubber mat, 1 set street tools, 2 earthen spittoons, 6 brass spittoons, 6 waste paper baskets, 1 shovel (historic), 2 mirrors, 1 letter copying press, 2 umbrella racks, 20 inkstands, 2 pen racks, 4 book racks, set tools (hammer, wrench, 2 screwdrivers, wire cutter, 1 plane, 1 saw, 1 chisel), 3 tumblers, boot-blackening outfit, 1 hair brush, 1 clothes brush, 1 match chest, 1 fire insurance map of Lowell, 1 atlas city of Lowell, 5 tin yearly boxes, 1 set Massachusetts statutes, 1 large dictionary, 1 large photograph album, 1 revolving bookcase, 1 card index case.





24-inch heads and rods for floating pipe, 19 hand hole gaskets, 1 upper portion of Chapman valve hydrant, 3 tops and 2 barrels of Chapman hydrant, top portion of 1 4-inch and 1 5-inch Chapman hydrant, 61 assorted gate spindles, 4 disc for Boston gate, 1 8-inch, 2 6-inch, 1 4-inch 12 brass castings for gate spindles, 6 brass castings for travellers, 23 brass castings for stems for hydrant tops, 33 brass parts of spindles for hydrants, 12 spindles for independent valves for Chapman hydrants, 30 leather valves, 40 caps for the various kinds of hydrants, 39 hydrant nipples, 2 stuffing boxes for Boston post hydrant, 1-2 doz rubber valves for 4-inch Michigan hydrant, 5 rubber valves for Eddy hydrant, 14 6-inch, 6 4-inch rubber valves for Ludow hydrant, 87 rubber gaskets for hydrants, 15 rubber gaskets for Ludlow hydrants, 100 lbs. Norway iron, 16 rubber gaskets for Lowry hydrants, 10 6-inch, 11 8-inch gaskets for Boston gates, 11 tops for Boston post hydrants, 3 wastes for Boston post hydrant, 1 waste for Lowry hydrant, 26 dippers for fountains, 1-2 doz. 1-4 turns for drinking fountains, 8 iron trap-screws for hydrants, 12 flanges for fountains, 13 sets of old couplings for 2 1-2-inch hose, 1 weight for check valve, 1 box and set of hydrant tools, 1 box of packing for gates, 13 wrench nuts for gate spindles, 1 set of tools for fountains, 1 dry tapping machine and drills, 1 2-inch boring machine, 30 bolts for flush hydrants, 5 bolts for hydrant valves, 1 packing can, 26 assorted spindles for post hydrants, 6 iron plates for gates, 200 lbs. 2-inch lead pipe, 250 lbs. 4-inch lead pipe, 83 lbs. sheet lead, 2 wrenches for gate post, 2 2-inch carpenter's chisels, 10 gate wrenches, 17 handles for cellar cocks, 46 6 x 3-4-inch iron bolts, 9 fountain backs, 5 fountain bottoms, 11 fountain aprons, 11 guards for dog troughs, 1 dog trough, 1 2-inch gooseneck flange connection, 3 20-inch manhole gaskets, 15 feet 2-inch brass pipe, 7 feet 4-inch brass pipe, 128 feet 3-4-inch extra hard lead lined pipe, 3125 feet 1-inch lead lined iron pipe, 437 feet 3-4-inch, 156 feet 2-inch, 280 feet 1 1-2 inch, 89 feet 1 1-4-inch, 380 feet 1-inch tin lined iron pipe, 270 feet 3-4-inch tin lined iron pipe, 20 feet 3-inch iron pipe, 60 feet 2-inch, 75 feet 1 1-2-inch, 40 feet 1-inch, 150 feet 5-8-inch brass pipe.

IRON FITTINGS.—59 right and left couplings, various sizes, 84 1-inch couplings, 20 2-inch, 35 1 1-2-inch, 18 3-4-inch, 16 1 1-4-inch, 64 1x1-2-inch, 7 2 x 1 3-4-inch tees, 7 2-inch unions, 5 1 1-2-inch, 60 1-inch, 2

1 1-4-inch, 5 2-inch plugs, 6 1 1-2-inch, 14 1-inch, 9 1 1-4-inch, 1 2-inch caps, 4 2-inch, 1 1 1-2-inch, 5 1 1-2 x 1-inch couplings, 2 1 1-2 x 3-4-inch, 12 1 x 1-2-inch elbows, 20 1-inch, 6 3-4-inch, 3 1 1-2-inch, 2 3-inch, 4 2-inch, 3 1 1-2-inch 1-8 bends, 1 2-inch 1-8 bend, 1 2 x 1 1-2-inch cross, 3 2 x 1-inch, 2 2 x 3-4-inch, 6 1 1-2 x 1-inch, 1 1 1-4-inch, 2 1 1-4 x 3-4-inch, 5 1-inch, 6 1 x 3-4-inch, 2 1 1-4 x 1 1-4 x 3-4-inch tees, 2 2 x 2 x 3-4-inch, 1 1 1-2-inch, 2 1 1-4-inch tees, 2 1 1-4 x 1-2-inch, 1 1 1-2-inch, 12 1-inch, 2 3-4 x 1-2-inch, 18 2-inch nipples, 14 1 1-2-inch, 35 1-inch, 13 1 1-4-inch, 5 3-4-inch, 2 1 1-2 x 1 1-4-inch bushings, 10 1 1 2 x 1-inch, 3 1 1-4 x 1-inch, 1 1 1-2 x 1-2-inch, 35 1 x 1-2-inch, 16 1 x 3-4-inch, 12 3-4 x 1-2-inch.

LEAD LINED FITTINGS.—35 3-4-inch couplings, 31 1-inch, 4 1 1-4-inch, 9 1 1-2-inch, 18 2-inch, 93 3-4 x 1-2-inch, 7 1 x 3-4-inch, 5 2 x 1 1-2-inch, 12 2-inch unions, 19 1 1-2-inch, 2 1 1-4-inch, 1 3-4-inch, 4 1 1-2-inch elbows, 1 2-inch, 66 3-4-inch, 41 3-4 x 1-2-inch, 58 1 x 3-4-inch, 4 2-inch 1-8 bends, 12 3-4-inch, 5 1 1-2-inch, 47 3-4-inch nipples, 22 1-inch, 18 2 x 3-4-inch tees, 9 2 inch, 5 1 1-2-inch, 6 1 1-2 x 1-inch, 4 1 1-2 x 3-4-inch, 25 1 x 3-4-inch, 47 3-4-inch, 6 2 x 1-inch crosses, 2 2 x 3-4-inches, 4 1 1-2 x 3-4-inch, 6 2 x 1-inch, 3 2 x 1-2-inch.

TIN LINED FITTINGS.—5 1 inch couplings, 2 3-4-inch, 8 1 inch tees, 15 3-4-inch, 1 2-inch plug cock for testing machine.

MUELLER COCKS.—7 2-inch corporations, 11 1 1-2-inch corporations, 7 1 1-2-inch sidewalk cocks, 12 3-4-inch, for iron, 12 3-4-inch, for lead and iron, 12 3-4-inch for lead.

Two 2-inch plug cocks, 31 1-inch corporation cocks, 8 3-4-inch, 21 1-inch sidewalk cocks, 94 3-4 inch, 17 1-inch cellar cocks, 10 3-4-inch, 113 1-inch solder nipples, 154 3-4 inch, 112 1-inch smooth tail pieces, 44 1-inch unions for cellar cocks, 31 3-4-inch corporation nipples, 28 1 1-4 x 1-inch solder nipples, 2 1 1-2 x 1 1-4-inch, 54 3-4-inch, 15 1-4-inch turns for fountains, 17 finished nuts for unions, 4 1-inch plugs, brass castings, 42 plugs for 3-4 inch corporation cocks, 4 1-inch, 15 plugs for 3-4-inch sidewalk cocks, 20 1-inch, 19 barrels for 3-4-inch sidewalk cocks, 30 1-inch, 162 barrels for 3-4-inch corporation cocks, 6 1-inch, 148 corporation nipples, 1-inch. 131 3-4-inch unions, 79 nuts for 3-4-inch unions, 170 1 x 3-4-inch couplings, 203 tail pieces for cellar cocks, 36 3-4 x 1-2-inch elbows, 45 1-inch, 70 1-inch washers, 62 3-4-inch nipples.

Three 1-inch Crown meters, 3 3-4-inch Crown meters, 5 5-8-inch

Crown meters, 4 3-4-inch Empire meters, 3 5-8-inch Empire meters, 2 3-4-inch Nash meters, 9 3-4-inch Union meters, 2 5-8-inch Union meters, 3 3-4-inch Lambert meters, 8 5-8-inch Lambert meters, 3 3-4-inch Trident meters, 9 5-8-inch Trident meters, 2 5-8-inch Hersey meters, 5 3-4-inch Columbia meters, 6 5-8-inch Columbia meters, 4 2-inch Worthington meters, 1 3-inch Worthington meter, 4 1 1-2-inch Worthington meters, 1 1-inch Worthington meter, 9 5-8-inch Worthington meters, 15 covers for 3-4-inch Crown meters, old style, 17 covers for 3-4-inch Crown meters, A, 5 covers for 3-4-inch Crown meters, a a, 6 covers for 1-inch Crown meters, 11 covers for 5-8-inch Crown meters, old style, 2 covers for 5-8-inch Crown meters a, 4 covers for Crown meters a a, 7 covers for 5-8-inch Nash meters, 5 bottoms for 3-4-inch Empire meters, 5 bottoms for 3-4-inch Trident meters, 2 bottoms for 5-8-inch Trident meters, 12 clocks for 1 1-2-inch and 2-inch Worthington meters, 30 clocks for 5-8-inch and 3-4 inch Worthington meters, 10 tops and ratchets for Worthington meters, 186 1 x 3-4-inch brass nipples, 84 3-4 x 1 2-inch brass couplings, 17 1 x 1-2-inch brass elbows, 51 1-inch brass elbows, 59 1 x 3-4-inch brass elbows, 51 3-4-inch brass elbows, 30 1 x 1-2-inch brass couplings, 12 1 x 3-4-inch brass couplings, 50 set 5-8-inch meter couplings, 88 set 3-4-inch meter couplings, 3 set 1-inch meter couplings, 8 quires of emery cloth, 5 stubb hack-saws, 12 hack-saws, 4 dozen lava gas tips, 6 fine saw files, 12 coarse saw files.



# REPORT OF CITY ENGINEER.

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OFFICE OF CITY ENGINEER,

LOWELL, MASS., Jan. 1, 1900.

*To the Lowell Water Board: .*

GENTLEMEN—I have the honor to submit the Twenty-seventh Annual Report for the year ending December 31st, 1899:

## PUMPAGE.

Total net Pumpage for 1899 . . .	2,659,052,210	Gals.
Total net Pumpage for 1898 . . .	2,452,212,843	“
An increase in 1899 of . . .	206,839,367	“

## CONSUMPTION.

Consumption for 1899 . . .	2,659,464,909	“
Consumption for 1898 . . .	2,454,575,265	“
An increase in 1899 of . . .	204,889,644	“

The greatest quantity pumped in one day in 1899 was 10,569,436 gallons, on July 21st.

The greatest quantity pumped in one week was 62,509,372 gallons, which was pumped during the week of July 16th—July 22d.

The pumpage for high service during the year was 50,590,456 gallons, which is 10,505,950 gallons more than was pumped in 1898.

The cost of pumping into the high service reservoir was ten dollars and thirty-eight cents (\$10.38) per million gallons, which, added to the cost of low service pumpage, fourteen dollars and seventy-three cents (\$14.73), makes the total cost of high service pumpage twenty-five dollars and eleven cents (\$25.11) per million gallons.

The discrepancy between the pumpage at Station No. 4 and the pumpage at Station No. 1 may be accounted for by the large quantity of water used in the condensers at Station No. 1, and, in addition by the occurrence of a leak which was discovered in the pump well at that station, caused by the breakage of the one and one-half inch drain pipe.

In addition to the quantity of water pumped at Station No. 3, it is estimated that the wells at that station have furnished 270,988,000 gallons, which have been pumped by the engines at Station No. 2, through the suction main which was laid for that purpose.





TABLE SHOWING SOURCE OF SUPPLY, QUANTITY PUMPED AND COST AT THE  
SEVERAL STATIONS DURING THE YEAR 1899.

PUMPING STATIONS.	SOURCE OF SUPPLY—WELL WATER.				COST.	
	169 Driven Wells at Pawtucket Boulevard.	90 Driven Wells at City Farm.	130 Driven Wells in Chelmsford, Mass.	Distributing Mains of Low Service System.	Total in U. S. Gallons.	Total.  Per Million Gallons.
No. 1 (West Sixth St.)						
Low Service.....	1,596,948,580	.....	.....	.....	1,596,948,580	\$13,437 82 \$8 41+
High Service.....	.....	.....	.....	50,590,456	50,590,456	524 94 10 38—
No. 2 (Cook Wells).....	.....	965,247,229	.....	.....	965,247,229	13,939 74 14 44 +
No. 3 (Hydraulic Wells).....	.....	.....	96,856,401	.....	96,856,401	1,969 29 20 33 +
No. 4 (Boulevard Wells).....	1,667,162,640	.....	.....	.....	1,667,162,640	9,828 50 5 90—
Total Pumpage .....					4,376,805,306	
Deduct quantity pumped twice— Pumped at Station No. 4 and repumped at Station No. 1...	1,667,162,640					
Repumped by High Service....	.....	.....	.....	50,590,456	1,717,753,096	
Net Pumpage.....					2,659,052,210	\$39,700 29 \$14 93 +
Exclusive of High Service pump- age.....						14 73 +

The following tables showing the performance of the engines at Station No. 1 on West Sixth Street, depth and quantity of water in reservoir, average temperature of air and water, and the average monthly and daily consumption of water, have been calculated and compiled from the records of the engineer and gatekeeper.

TABLE SHOWING WORK DONE WITH WORTHINGTON HIGH DUTY ENGINE FOR EACH MONTH DURING THE YEAR 1899.

MONTHS.	No. of days pumping.	Average No. of hours pumping per day.	No. of hours pumping per month.	Average No. of strokes made per minute.	Average head, including friction in feet.	Quantity pumped per month in U. S. gallons.	Average Quantity pumped per day in U. S. gallons.	No. gals. of water pumped into reservoir per lb. total coal consumed.	Duty in lbs. 1 ft high with 100 lbs. coal, used in pumping only; no deduction for ashes or clinkers.	Duty on total coal consumed; no deduction for ashes or clinkers.
January.....	1	7-30	7-30	7.00	164.23	1,180,875	1,180,875	492	80,812,755	67,343,969
February.....	14	20-21	285-00	7.00	163.79	51,248,625	3,660,616	586	84,932,725	79,980,444
March.....	31	20-39	640-00	7.65	164.14	110,000,625	3,551,310	616	92,045,064	84,315,077
April.....	4	10-15	77-00	8.06	164.33	13,966,500	3,491,625	538	82,531,434	73,635,220
May.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
June.....	3	16-20	49 00	9.87	164.20	10,879,500	3,626,500	726	99,392,318	99,392,318
July.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
August.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
September.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
October.....	23	23-13	534-00	9.38	163.40	112,732,125	4,901,397	697	96,551,457	94,960,413
November.....	26	20-30	537-00	10.43	163.76	126,046,875	4,847,957	685	93,486,152	93,486,152
December.....	31	23-52	740-00	9.81	164.20	163,306,875	5,270,867	621	86,963,250	84,963,250
Totals and Averages.....	133	21-36	2860-30	9.13	163.94	589,542,000	4,432,647	642	90,085,500	87,701,980

TABLE SHOWING WORK DONE WITH WORTHINGTON DUPLEX ENGINE FOR EACH MONTH DURING THE YEAR 1899.

MONTHS.	No. of days pump- ing.	Average No. of hours pumping per day.	No. of hours pumping per month.	No. of strokes made per month.	Average No. of strokes made per minute.	Average head, in cluding friction in feet.	Quantity pumped per month in U. S. gallons.	Average quantity pumped per day in U. S. gallons.	No. gals. of water pumped into reser- voir per lb. total coal consumed.	Duty in lbs. 1 ft. high with 100 lbs. coal used in pump- ing only; no deduction for ashes or clinkers.	Duty on total coal consumed; no deduction for ashes or clinkers.
January.....	31	20-35	638 00	345,876	9.04	162.32	107,221,560	3,458,760	335	46,981,402	45,294,229
February.....	15	23-00	345-00	178,641	8.63	167.01	55,378,710	3,691,914	352	49,168,191	48,949,618
March.....	....	.....	.....	.....	.....	.....	.....	.....	....	.....	.....
April.....	27	16-50	454-30	240,751	8.83	166.65	74,632,810	2,764,178	361	53,844,309	50,169,690
May.....	16	18-26	295-00	182,768	10.33	165.03	56,658,080	3,541,130	373	54,393,537	51,279,435
June.....	29	22-57	665-30	450,305	11.28	162.23	139,504,550	4,813,605	414	56,023,494	55,907,321
July.....	21	20-56	439-30	300,880	11.41	162.34	93,272,800	4,441,562	406	56,999,623	54,868,266
August.....	5	14-45	73-45	51,536	11.65	164.17	15,976,160	3,195,232	376	53,728,741	51,452,262
September.....	4	13-30	54-00	37,609	11.62	164.18	11,658,700	2,914,697	482	65,900,121	65,900,121
October.....	....	.....	.....	.....	.....	.....	.....	.....	....	.....	.....
November.....	....	.....	.....	.....	.....	.....	.....	.....	....	.....	.....
December.....	....	.....	.....	.....	.....	.....	.....	.....	....	.....	.....
Totals and Averages.....	148	20 02	2965-15	1,788,366	10.05	163.97	554,393,460	3,745,902	377	53,185,432	51,518,119



**TABLE SHOWING WORK DONE WITH MORRIS ENGINE (BEAM AND FLY WHEEL) FOR  
EACH MONTH DURING THE YEAR 1899.**

MONTHS	No. of days pump- ing	Average No. of hours pump- ing per day.	No. of hours pump- ing per month
January.....	..	..	..
February.....	..	..	..
March.....	..	..	..
April.....	..	..	..
May.....	18	16-45	291-21
June.....	..	..	..
July.....	17	17-41	299-21
August ..	30	22-12	663-04
September ..	29	22-44	650-11
October..	9	22-57	205-21
November...	10	13-48	134-04
December.....	..	..	..
Totals and Averages .....	113	20-46	2271-41

TABLE SHOWING AMOUNT OF COAL USED FOR WORTHINGTON HIGH DUTY ENGINE AT PUMPING STATION DURING THE YEAR 1899.

MONTHS.	COAL CONSUMED.			
	For starting fires, in lbs.	When pumping, in lbs.	For banking fires, in lbs.	Total per month, in lbs.
January, .....	400	2,000	....	2,400
February .....	1,900	82,366	3,200	87,466
March .....	7,000	163,613	8,000	178,613
April .....	1,200	23,176	1,600	25,976
May .....	.....	.....	.....	.....
June ... ..	.....	14,979	.....	14,979
July .....	.....	.....	.....	....
August .....	.....	.....	.....	.....
September .....	.....	.....	.....	.....
October .....	1,000	160,663	....	161,663
November .....	.....	184,012	... ..	184,012
December .....	.....	263,316	.....	263,316
Totals .....	11,500	894,125	12,800	918,425

TABLE SHOWING AMOUNT OF COAL USED FOR WORTHINGTON DUPLEX ENGINE AT PUMPING STATION  
DURING THE YEAR 1899

MONTHS.	COAL CONSUMED.			
	For starting fires, in lbs.	When pump- ing, in lbs.	For banking fires, in lbs.	Total per month, in lbs.
January .....	4,700	308,732	6,800	320,232
February .....	300	156,767	400	157,467
March .....	.....	.....	.....	.....
April .....	5,600	192,508	8,500	206,608
May .....	4,100	143,262	4,600	151,962
June .....	300	336,886	400	337,586
July .....	3,000	221,392	5,600	229,992
August .....	1,000	40,683	800	42,483
September .....	.....	24,207	... ..	24,207
October .....	.....	.....	.....	.....
November .....	.....	.....	.....	.....
December .....	.....	.....	.....	.....
Totals. ....	19,000	1,424,437	27,100	1,470,537

TABLE SHOWING AMOUNT OF COAL USED FOR MORRIS  
ENGINE AT PUMPING STATION  
DURING THE YEAR 1899.

MONTHS.	COAL CONSUMED.			
	For starting fires, in lbs.	When pump- ing, in lbs.	For banking fires, in lbs.	Total per month, in lbs.
January .....	.....	.....	.....	.....
February .....	.....	.....	.....	.....
March .....	.....	.....	.....	.....
April .....	.....	.....	.....	.....
May .....	7,000	73,535	7,200	87,735
June .....	.....	.....	.....	.....
July .....	3,700	97,438	2,200	106,338
August .....	800	211,104	.....	214,104
September .....	.....	223,964	2,200	223,964
October .....	.....	68,847	.....	68,847
November .....	.....	72,644	.....	72,644
December .....	.....	.....	.....	.....
Totals ... ..	11,500	747,532	14,600	773,632





TABLE SHOWING WORK DONE WITH WORTHINGTON HIGH SERVICE ENGINE FOR  
EACH MONTH DURING THE YEAR 1899.

MONTHS.	No. of days pump- ing.	Average No. of hours pumping per day.	No. of hours pumping per month.	No. of strokes made per month.	Average No. of strokes made per minute.	Average head including friction in feet.	Quantity pumped per month in U. S. gallons.	Average quantity pumped per day in U. S. gallons.	No. gals. of water pumped into reser- voir per lb. total coal consumed	Coal in lbs. used when pumping.
January.....	13	14-05	183-00	165,283	15-05	69-44	2,313,962	177,997	300	7,709
February.....	18	20-17	345-00	216,769	9-00	69-44	3,034,766	168,598	300	10,107
March.....	16	20-08	322-00	204,782	10-60	69-44	2,866,948	179,194	300	9,552
April.....	12	14-20	172-00	167,342	16-22	69-44	2,342,788	195,232	300	7,806
May.....	17	16-49	286-00	233,581	13-61	69-44	3,270,134	192,361	300	10,888
June.....	28	23-24	660-00	370,160	9-35	89-79	5,182,240	185,080	219	17,331
July.....	31	24-00	744-00	489,850	10-97	92-06	6,857,900	221,223	300	22,890
August.....	31	24-00	744-00	565,445	12-47	92-59	7,916,230	255,362	301	26,336
September.....	30	24-00	720-00	522,510	12-10	92-59	7,315,140	243,838	300	24,379
October.....	18	20-43	373-00	321,390	14-36	75-87	4,499,460	249,970	301	14,970
November.....	10	16-06	161-00	172,310	17-84	69-44	2,412,340	241,234	300	8,035
December.....	9	17-07	154-00	184,182	19-93	69-44	2,273,548	286,505	300	8,591
Totals and Averages.....	223	20-58	4884-00	3,613,604	12-33	81-46	50,590,456	217,126	300	168,594

**PUMPING STATION NO. 1, WORTHINGTON HIGH DUTY ENGINE.  
RUNNING EXPENSES FOR YEAR 1899.**

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Pay of engineers and firemen.....	\$2,338 69
147 455-2000 tons of coal (Cumberland, 1898), at \$3.393.....	499 54
311 1970-2000 tons of coal (Cumberland, 1899), at \$3.379. ..	1,054 20
Electric light.....	89 46
Gas for lighting works.....	51 80
115 gallons cylinder oil, at 0.551.....	63 36
123.7 gallons of engine oil, at 0.298.....	36 86
136.4 pounds of packing, at 0.987.....	134 63
64.8 pounds of cotton waste, at 0.06 1 4.....	4 05
26 pounds of tallow, at 0.04 1-2.....	1 17
Repairs on engine.....	162 75
Repairs on boilers.....	100 01
Tools and stock.....	19 49
Sundries.....	38 53
	<hr/>
Total.....	\$4,594 54

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Cost of pumping water into reservoir per million gallons, \$7.79--

Cost of pumping water one foot high per million gallons, .04 75-100.



PUMPING STATION NO. 1, WORTHINGTON DUPLEX ENGINE.  
 RUNNING EXPENSES FOR THE YEAR 1899.

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Pay of engineers and firemen.....	\$2,143 79
366 1260-2000 tons of coal (Cumberland, 1898), at \$3,393....	1,243 98
368 1277-2000 tons of coal (Cumberland, 1899), at \$3,379....	1,245 63
Electric light.....	82 00
Gas for lighting works.....	47 49
105.4 gallons of cylinder oil, at 0.551.....	58 08
113.4 gallons of engine oil, at 0.298 ...	33 79
125 pounds of packing, at 0.987.....	123 37
59.4 pounds of cotton waste, at 0.06 1-4.....	3 71
40 pounds of tallow, at 0.04 1-2.....	1 80
Repairs on engine....	10 85
Repairs on boilers.....	91 67
Tools and stock.....	17 87
Sundries.....	35 32
<hr/>	
Total.....	\$5,139 35

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Cost of pumping water into reservoir per million gallons, \$9.27 --  
 Cost of pumping water one foot high per million gallons. .05 65 100.

PUMPING STATION NO. 1, MORRIS ENGINE. RUN-  
NING EXPENSES FOR THE YEAR 1899.

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Pay of Engineers and firemen.....	\$1,818 98
12 477-2000 tons of coal (Cumberland, 1898), at \$3.393.....	41 53
374 1155-2000 tons of coal (Cumberland, 1899), at \$3.379....	1,265 70
Electric light.....	69 58
Gas for lighting works.....	40 29
89.5 gallons of cylinder oil, at 0.551.....	49 31
96.2 gallons of engine oil, at 0.298.....	28 67
106.1 pounds of packing, at 0.987.....	104 72
50.4 pounds of cotton waste, at 0.06 1-4.....	3 15
50 pounds of tallow, at 0.04 1-2....	2 25
Repairs on engine.....	156 84
Repairs on boilers.....	77 79
Tools and stock.....	15 16
Sundries.....	29 96
<b>Total.....</b>	<b>\$3,703 93</b>

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Cost of pumping water into reservoir per million gallons, \$8.18 —

Cost of pumping water one foot high per million gallons, .05 7-100.

## RESERVOIR, BEACON STREET, 1899.

MONTHS.	Depth in feet.	Quantity in U. S. Gallons.	Temperature in degrees.	
			Of water.	Of air.
January.....	19.27	29,278,986	40.19	24.92
February.....	18.24	27,574,982	38.01	24.20
March.....	19.24	29,231,520	41.55	31.84
April.....	19.48	29,641,085	45.76	47.54
May.....	18.33	27,718,474	53.40	58.16
June.....	18.10	27,335,247	60.35	71.47
July.....	19.09	28,981,899	61.82	74.16
August.....	19.14	29,073,894	65.05	69.99
September.....	17.68	26,645,951	64.81	61.77
October.....	19.57	29,797,956	59.40	52.95
November.....	19.60	29,841,413	50.15	39.32
December.....	19.41	29,513,750	44.66	33.30

TABLE SHOWING THE AVERAGE MONTHLY AND DAILY CONSUMPTION OF WATER FOR THE YEAR 1899.

MONTHS.	Gallons per month.	Gallons per day.
January .....	229,949,301	7,417,719
February .....	227,198,933	8,114,248
March .....	210,898,627	6,803,182
April ....	196,648,894	6,554,963
May .....	203,103,674	6,551,731
June .....	255,243,127	8,508,104
July.....	268,591,085	8,664,229
August.....	223,079,983	7,196,128
September.....	210,060,501	7,002,017
October.....	218,147,464	7,037,015
November.....	203,938,563	6,797,952
December .....	212,604,757	6,858,218
Totals and averages.....	2,659,464,909	7,286,205

## SUMMARY OF STATISTICS.

## REPORT OF 1899.

In accordance with the recommendations of the New England Water Works Association.

## LOWELL WATER WORKS, MIDDLESEX COUNTY, MASS.

Population by census of 1895, 84,359.

Date of construction, 1870 to 1873.

Date of construction, High Service, 1881.

Date of construction, Driven Wells, 1893 to 1896.

Source of supply—two hundred twenty (220) driven wells in the valley of River Meadow Brook and one hundred sixty-nine (169) driven wells at Pawtucket Boulevard.

Mode of supply, pumping to reservoir and pumping direct.

## PUMPING.

## 1. Builders of pumping machinery:

## AT STATION NO. 1.

One engine, capacity 5,000,000 gals, in 24 hours,  
Henry G. Morris.

One engine, capacity 5,000,000 gals, in 24 hours,  
Henry R. Worthington.

One engine, capacity 10,000,000 gals. in 24 hours,  
Henry R. Worthington.

One engine, capacity 500,000 gals. in 24 hours,  
Henry R. Worthington.

## AT STATION NO. 2, TEMPORARY PUMPS.

One engine, capacity 3,000,000 gals. in 24 hours,  
The Deane Steam Pump Co.

One engine, capacity 3,000,000 gals. in 24 hours,  
The Deane Steam Pump Co.

## AT STATION NO. 3, TEMPORARY PUMPS.

One engine, capacity 3,000,000 gals. in 24 hours,  
Henry R. Worthington.

One engine, capacity 3,000,000 gals. in 24 hours,  
Henry R. Worthington.

## AT STATION NO. 4, TEMPORARY PUMPS.

One engine, capacity 3,000,000 gals. in 24 hours,  
Knowles Steam Pump Works.

One engine, capacity 3,000,000 gals. in 24 hours,  
Knowles Steam Pump Works.

## 2. Description of coal used :

(b) Kind, bituminous.

(c) Size, broken.

(d) Brand, Cumberland.

(e) Price per gross ton delivered, \$3.85 +.

3. Coal consumed for the year, in pounds, 10,173,433  
(3,162,594, Station No. 1).

## 4. Wood consumed for the year, in pounds,

\_\_\_\_\_ = coal in lbs. = 2,400, Station No. 1.

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5. Total fuel consumed for the year, in pounds, 3,164,994,  
Station No. 1.







6. Total pumpage for the year, in gallons, 2,659,052,210, (1,596,948,580, Station No. 1).
7. Average static head against which pumps work, 156.22, Station No. 1.
8. Average dynamic head against which pumps work, 163.07, Station No. 1.
9. Number of gallons pumped per pound of coal, 266, (505, Station No. 1).
10. Duty in foot pounds per 100 pounds of coal, using the following formula, making no deduction for starting or banking fires, or heating building:

$$\text{Duty} = \frac{\text{Gallons pumped (6)} \times 8.34 \text{ (lbs.)} \times 100 \times \text{dynamic head (8)}}{\text{Total fuel consumed (5)}} = 68,621,177, \text{ Station No. 1.}$$

COST OF PUMPING FIGURED ON PUMPING STATION EXPENSES OF \$13,437.82, STATION NO. 1.

11. Per million gallons raised against average dynamic head (8) into reservoir, \$8.41, Station No. 1.
12. Per million gallons raised one foot high (dynamic), \$0.05 16-100.

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Analyses of the water from the several driven well plants, Merrimack River and Station No. 1, have been made each month by the State Board of Health, a record of which is annexed.

Respectfully submitted,

GEORGE BOWERS,

City Engineer.

COMMONWEALTH OF MASSACHUSETTS.—STATE BOARD OF HEALTH, LOWELL.  
WATER ANALYSIS—Merrimack River.  
(PARTS IN 100,000.)

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COMMONWEALTH OF MASSACHUSETTS.—STATE BOARD OF HEALTH, LOWELL.  
WATER ANALYSIS—COOK AND HYDRAULIC WELLS AND COOK WELLS.  
(PARTS IN 100,000.)

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\*Cook and Hydraulic Wells.  
†Cook wells.

**COMMONWEALTH OF MASSACHUSETTS.—STATE BOARD OF HEALTH, LOWELL.**  
**WATER ANALYSIS.—BOULEVARD WELLS.**  
(PARTS IN 100,000.)

NO.	DATE OF		APPEARANCE.			ODOR		Total	Loss on igni.	Fixed.	AMMONIA.			Chloride	AS		Hardness	Iron.	Oxygen Consumed
	Collection	Examination	Turbidity.	Sediment.	Color.	Cold.	Hot.				Free	Albuminoid.			Nitrates.				
												Total	In solution.			In suspension.			
25,962	Jan., 1890. 17 18		Very Slight.	Very Slight.	0.12	None	None.	4.80	....	....	.0076	None	....	.26	.0180	.0000	2.0	.0380	.06
26,218	Feb 14 16		Slight.	Slight.	0.17	Faintly Earthy.	None.	4.70	....	....	.0166	.0024	....	.26	.0160	.0001	2.0	.0400	.06
26,472	Mar 14 15		None.	Very Slight.	0.18	None.	None.	4.80	....	....	.0094	.0024	....	.26	.0180	.0001	1.7	.0550	.0500
27,111	May 16 17		Slight Milky.	Slight.	0.11	None.	None.	4.90	....	....	.0162	.0026	....	.26	.0300	.0001	1.8	.0680	.06
27,496	June 20 21		Very Slight.	Very Slight.	0.16	None.	None.	4.40	....	....	.0004	.0032	....	.26	.0180	.0001	1.3	.0200	.07
27,800	July, 19 19		Slight.	Very Slight.	0.11	None.	None.	4.40	....	....	.0104	.0040	....	.26	.0180	.0002	1.3	.0200	.10
28,216	Aug. 15 16		Slight.	Slight.	0.12	None.	None.	4.00	....	....	.0094	.0038	....	.26	.0200	.0002	1.3	.0450	.14
28,662	Sept 19 20		Slight	Very Slight.	0.16	None.	None.	4.60	....	....	.0106	.0038	....	.29	.0170	.0002	1.7	.0200	.09
29,030	Oct 16 17		Slight Milky.	Slight.	0.12	None.	None.	4.50	....	....	.0082	.0028	....	.31	.0220	.0001	1.7	.0400	.09
29,294	Nov 14 16		Very Slight.	Very Slight Iron.	0.09	None.	None.	4.50	....	....	.0100	.0050	....	.31	.0150	.0001	1.7	.0370	.06
29,727	Dec. 20 21		Very Slight.	Very Slight.	0.07	None.	None.	4.40	....	....	.0100	.0030	....	.31	.0140	.0001	1.8	.0400	.06





COMMONWEALTH OF MASSACHUSETTS.—STATE BOARD OF HEALTH, LOWELL.  
WATER ANALYSIS.—PUMPING STATION NO. I.  
(PARTS IN

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